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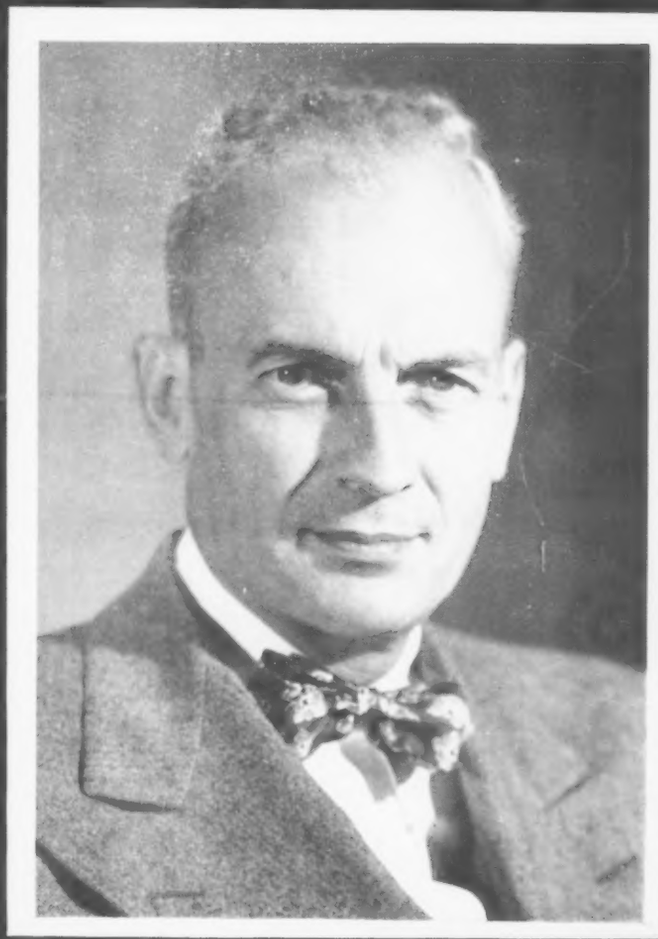
ARMED FORCES CHEMICAL JOURNAL



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Prepared by the joint Technical Staffs of Pittsburgh Plate Glass Company, Columbia Chemical Division, and Southern Alkali Corporation, this 72-page Chlorine Manual is just off the press. It presents basic information and data which is useful to technical, transportation and purchasing men, and of interest to managing executives and others who are concerned with the buying, handling and use of Chlorine. We shall be glad to send you a copy. Just send your request on your company letterhead. Pittsburgh Plate Glass Company, Columbia Chemical Division, Fifth at Bellefield, Pittsburgh 13, Pa.

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Armed Forces Chemical Journal

OFFICIAL PUBLICATION OF THE ARMED FORCES CHEMICAL ASSOCIATION
Room 523, 1129 Vermont Ave. N.W.
Washington 5, D. C.
LT. COL. HAROLD B. RODIER, *CmlC, Ret.*, Editor

VOL. III | OCTOBER, 1948 | No. 2

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THE PICTURE ON THE COVER

Donald F. Carpenter, whose appointment as Chairman of the Munitions Board was recently announced by the White House.

Mr. Carpenter is a member of the Corporation of the Massachusetts Institute of Technology and Vice President of the Remington Arms Company. Residence, Southport, Connecticut.

Mr. Carpenter became Deputy to the Secretary of Defense in atomic energy matters on April 8, 1948, and was made Chairman of the Military Liaison Committee of the Atomic Energy Commission. Prior to this appointment he had served from October 1947 as a member of the Industrial Advisory Group to the Atomic Energy Commission.

INDEX

Airflow Characteristics of the Breather Pump 44
By Jess W. Thomas
Chapter News 56
Chemical Corps Key Personnel 51
Chemical Warfare in World War II 23
Chlorine in World War II 29
By Robert T. Baldwin
Civilian Defense 25
By T. H. McHatton, Col. CmlRes
Col. Barker Retires 3
Development of the 4.2 Chemical Mortar 33
Editorial 2
"Exercise Yukon" 8
By Edward C. Bingham, Jr., Capt., CmlC
From the National Secretary 64
From Your National President 3
Items From Industry 62
Membership Campaign 5
By Lt. Col. Elliott Morrill, CmlRes
Pemco War Story 53
By G. H. Spencer-Strong
Plan to Eliminate ORC Composite Groups 2
Recent Chemical Warfare Literature 43
Quartermaster Reviews Our Book 23
Reserve Chemics Meet in Newark 24
Some Army Policies and Their Applications to the Chemical Corps Technical Command 13
By Duncan MacRae and L. Wilson Greene
Technical Command Symposium 4
By Dr. Rudolph Macy
They Couldn't See Down Into the Valley 16
By Houston C. Joyner, Lt. Col., CmlC

INDEX TO ADVERTISERS

Becco Sales Corp. 15
Diamond Alkali Co. 50
Dow Chemical Co. ..... Inside Back Cover
Dryden Rubber Division, Sheller Manufacturing Co. 59
Ernst Bischoff Co. 21
Evans Research and Development Co. 49
H. K. Ferguson Co. 28
Ferro Enamel Corp. 56
Harshaw Chemical Co. 24
Hooker Electrochemical Co. 12
Industrial Rubber Goods Co. 61
Marion Contracting Corp. 52
Niagara Alkali Co. ..... Back Cover
Pemco Corp. 57
Pittsburgh Coke & Chemical Co. 49
Pittsburgh Plate Glass Co. ..... Inside Front Cover
Professional Directory 32
Vulcan Copper & Supply Co. 58

". . . to sponsor new developments designed to increase the efficiency of chemical warfare means, to collect and disseminate useful knowledge with respect to chemical warfare and related subjects, to foster a spirit of good will and cooperative endeavor among its members and with industry, and to perpetuate the friendships, memories and traditions growing out of their service with the Chemical Corps . . ."

Armed Forces Chemical Association

COL. HARRY A. KUHN, USA, Ret., *President*
Washington, D. C.

FRED M. JACOBS, *Secretary-Treasurer*
Room 523, 1129 Vermont Avenue N.W.
Washington 5, D. C.

Publishers of

The Armed Forces Chemical Journal

Published quarterly: January, April, July and October
Subscription, $2.00 per year

Entered as Second Class matter at Washington, D. C.

LT. COL. HAROLD B. RODIER, *CmlC, Ret., Editor*
Room 523, 1129 Vermont Avenue N.W.
Washington 5, D. C.

Associate Editor
L. WILSON GREENE, *Col., CmlRes*

Vol. III **October, 1948** **No. 2**

FELLOWSHIP

If you served in the Chemical Warfare Service during the war and found satisfaction in that service you are probably anxious to keep in touch with your fellow officers and comrades. You will probably find in the companionship of men who served in the CWS a kinship and satisfying relationship that would be difficult to find in another group.

Military personnel, industrialists and scientists in the chemical industry whose work during the war brought them in contact with one another will undoubtedly find pleasure and satisfaction in renewing and maintaining such contacts.

The opportunity that our Association affords for the establishment and maintenance of such fellowship is not the least important of its functions.

Traditionally, Americans do business on an informal and personalized basis. Part of our national ability to get things done and get them done quickly is predicated upon this factor. Our Association furnishes a means for bringing men together, fostering good will and mutual understanding among those who served and worked together in the field of Chemical Warfare during the last war, and who may at any time be called upon to serve again.

This may prove of incalculable value should another war come. The men you meet through your Association have a similar background of service and experience. They are linked together by a common dedication to the defense of our nation in the field of chemical warfare. They share in common the expectation that they may once more so serve our nation.

If our Association had no other reason for being than the opportunity it thus affords for men of this common background to meet in fellowship, this would be a fully adequate reason for its existence.

PLAN TO ELIMINATE O.R.C. COMPOSITE GROUPS

During the past few months the results of the O.R.C. Reorganization Program have begun to show up in the activation of new training units throughout the various Army Areas. At present increasing numbers of Company grade Reserve Officers and some field grade Reserve Officers are being assigned to Table of Organization and Equipment, Table of Allowance, and Research and Development Units, thus reducing the number remaining in the old Composite groups. In order to give all Reservists the obvious advantages of more individualized training in small groups, special training units are now being planned which will eventually eliminate the Composite Groups entirely. While the process of establishing such training units must necessarily be a gradual one, based on local requirements, their formation should fill a long-felt need, especially among those Reserve Officers of field grade who cannot be fitted into existing training organizations.

Time Out - - - *By Chet Smith*

"That's what they get for booking a game with the boys from the Chemical Warfare Division!"

(Reproduced by permission)

From Your National President

The Association has made considerable progress in the past few months in its internal organization. Details have been reported in the *Journal* and *News*. The financial structure has been placed on a sound business basis. The membership lists have been thoroughly scrutinized and issued in the form of a directory. Changes in format and contents of the publication have been made. The appointment of area representatives has been started and limitations have been placed on the area covered by each chapter. Our two committees directly concerned with military planning agencies, research and development and mobilization planning, have been very active and have made important contributions. Much of the work of these committees is of restricted nature and full details cannot be given in our *Journal*. Eventually the results will be apparent.

One of the main reasons for forming the Association was to hold together the knowledge and experience of World War II for any future emergency. The value of holding together this information and experience may be apparent from a national defense standpoint, sooner than we anticipated three years ago. Much of the top level mobilization planning of the past two and a half years is being completed and specific utilization of the knowledge and experience represented in our membership will be definitely incorporated into these plans at various levels within the next few months. A casual review of the demands for technical personnel to staff the chemical T/O units, the research and development groups, industrial procurement agencies, the civil defense agencies as well as individual corporation military planning and civil defense groups indicate that the present total of available trained personnel will be far short of the demand. As soon as the classification bars are lowered we will publish as full details as possible to our membership.

The *Chemical Corps Journal* is the center of our Association, binding together our members in a fraternal relationship and the link joining us to the Chemical Corps. The *Journal* is the direct descendant of the *Chemical Warfare Bulletin* published as a Service Journal for 25 years by the staff of the Chemical Corps School. The policy of the Association *Journal* follows closely that of its predecessor, bringing you articles, technical, military, historical and personal, in line with the broad scope of interest of our members. To accomplish our objectives we must rely on contributions from our readers and from the Chemical Corps and other military services. We solicit your assistance in contributing articles of interest. Our *Journal* will be as good as you help make it.

HARRY A. KUHN,
Col., USA Ret.

COL. BARKER RETIRES, COL. MARSHALL NEW SCHOOL COMMANDANT

After completing 31 years of active service and after four years four months as Commandant of the Chemical Corps School, Col. Maurice E. Barker retired on 31 August 1948. Col. Barker became Commandant on 10 May 1944 after having been Chemical Officer, Fifth Army, in North Africa and Italy.

Col. Barker was commissioned as Second Lieutenant, Coast Artillery Corps, on 9 August 1917, transferred to the Chemical Warfare Service on 27 June 1924, and is a graduate of the first Line and Staff Course conducted at the Chemical Warfare School. He has a degree of Doctor of Science from Massachusetts Institute of Technology. He is also a charter member of the Chemical Corps Association.

Col. Barker has accepted a position as professor of chemical engineering and is head of that department at the University of Arkansas, and his address is 216 East Spring Street, Fayetteville, Arkansas.

The new Commandant, Col. Geoffrey Marshall, is not new at the school. He was secretary of the school from 1926 to 1930 and is a graduate of courses at the school in 1926 and 1931.

He, too, came in the Coast Artillery Corps in August 1917 and transferred to the Chemical Warfare Service in 1921. Col. Marshall comes to the school from a tour as Chemical Officer, Far East Command, Tokyo, and during the early part of World War II was Chief of Personnel in the Office of the Chief, Chemical Corps, followed by a tour as Commanding Officer, Huntsville Arsenal, Alabama.

The Technical Command Symposium

By RUDOLPH MACY

The Chemical Corps Technical Command at Army Chemical Center, Md., has successfully sponsored two symposia. These conferences have aroused considerable interest, and it was thought desirable to outline briefly in this article the manner in which they originated.

Symposium I

The first symposium took place in August 1947. Its origin was rather casual. The Chemical Corps has a considerable interest in the subject of aerosols and had let a number of research contracts, principally to universities qualified to carry on the work on this problem. The writer in July 1947 was tentatively charged with correlating the research on aerosols being done under various projects in the Technical Command and under contracts in the universities. Major Floyd Mitman, Chief, Munitions Division, in the Technical Command, came to me one day in July with the suggestion that we should invite several of our contractors on aerosols to a round table discussion. This appeared to be desirable in order to have our contractors meet each other and discuss mutual problems. In our first plan we considered sending invitations to from six to ten of our contractors, but after talking over this plan with several other personnel in the Command the number of suggested conferees began to grow to such a large figure that an ordinary conference room seemed to be out of the question. It then dawned on us that we ought to call this meeting a symposium and treat it like one.

Although it is permissible for us to state in the open literature that this first symposium was devoted to the aerosol problem, the subject matter itself is classified. For that reason practically no publicity was given to Symposium I except for a brief statement in this *Journal*, Vol. II, No. 2, October 1947. The attendance at Symposium I was rather impressive. A large number of prominent scientists from this country, Canada, and England were present. The symposium was highlighted by an impromptu lecture by Dr. Irving Langmuir of the General Electric Company, who had been invited to attend but who wasn't on the original program. The first symposium was quite successful, not only from the standpoint of the quality of the lectures, but from the point of view of summarizing and correlating the various aspects of aerosol research. Processing the papers presented at Symposium I required nearly ten

DR. RUDOLPH MACY
Army Chemical Center
Arranged the program and conducted the symposium.

months of fairly constant effort and, when printed, the papers comprised a report of 283 pages. It had not been a very difficult matter to obtain security clearance for guests to attend Symposium I because most of those invited had already been cleared in order to work on Chemical Corps contracts.

Symposium II

The success of Symposium I prompted a number of suggestions that there should be an annual symposium held at Army Chemical Center. This did not meet with the wholehearted approval of the writer because organizing the program, corresponding with the proposed speakers, and entering into discussions with security personnel on the propriety of certain papers is a rather arduous undertaking. The decision to prepare Symposium II was due largely to urging by Dr. Duncan MacRae, Chief Consultant of the Technical Command, who prepared a formal request for the Symposium and had it approved by our operating officials.

Since one of the principal reasons for Symposium II was to provide a medium by which scientists in this country could be made acquainted with the Chemical Corps, it was essential to prepare a program based on unclassified material. It was decided to make colloids the central theme of Symposium II since it is a subject adaptable to "open" treatment. The program was divided into two parts, the first of which was on the physical aspects of colloids, and the second on biochemical aspects of colloids. The program is given at the end of this article, and it will be seen that the symposium was given the general title, "Military Aspects of Colloids." Perhaps there wasn't much of what could be called military in the symposium, but the title at least served to give the program a martial atmosphere.

The symposium took place in the Post Theatre at Army Chemical Center. This theatre has a seating capacity of 400 and most of the seats were filled. The papers were presented on Monday and Tuesday, 27 and 28 June 1948, and on the third day the guests were given a conducted tour of Technical Command and Medical Division. Approximately 125 prominent scientists were present, including two Nobel Prize winners, Dr. Irving Langmuir and Dr. Peter Debye.

The welcoming address by Major General Alden H. Waitt is given elsewhere in this issue (p. 6) and a report of the symposium appeared in *Chemical and Engineering News*, 12 July 1948.

GENERAL PROGRAM

Army Chemical Center

Brig. General E. F. Bullene, Commanding

SYMPOSIUM II

Military Aspects of Colloids

Conducted by Chemical Corps Technical Command

Col. J. A. MacLaughlin, Commanding

Mr. L. Wilson Greene, Scientific Director

27 JUNE 1948

Participants will assemble at Army Chemical Center for assignment to quarters and for other preliminary details, under the direction of Captain Donald D. Limoncelli, Chief, Technical Services Division, Cml. C. Technical Command.

28 JUNE 1948 AT 9:00 A.M. IN POST THEATRE

Welcome to Army Chemical Center

Major Gen. Alden H. Waitt, Chief, Chemical Corps

Brig. Gen. E. F. Bullene, Commanding Officer, Army Chemical Center

Introductions by:

Col. John A. MacLaughlin, Commanding Officer, Technical Command

Col. William M. Creasy, Chief, Research & Engineering Division

28-29 JUNE 1948 AT 9:00 A.M. IN POST THEATRE

Presentation of Papers

Chairman: Dr. R. Macy, Chief, Chemical Division, Cml. C. Technical Command.

30 JUNE 1948

Tour of Technical Command 9:30 - 11:30 a.m.

Tour of Medical Division 2:00 - 4:00 p.m.

Symposium on Military Aspects of Colloids
Symposium II of the Cml. C. Technical Command
28-30 June 1948 at Army Chemical Center, Md.

PROGRAM

Part I. *Physical Aspects of Colloids*

1. Current Status of Adsorption Theories
   P. H. Emmett, Mellon Institute
2. Adsorption and Electron Valence Theory
   D. MacRae, Chief Consultant, Cml. C. Technical Command
3. Chromatographic and Ion Exchange Methods Applicable on a Plant Scale
   R. Kunin, Resinous Products & Chemical Co. (with J. C. Winters)

DR. A. ROTHEN
Rockefeller Institute for Medical Research

DR. P. J. FLORY
Goodyear Tire & Rubber Company

DR. W. D. HARKINS
University of Chicago

4. Viscosities of Polymers and Their Solutions
   P. J. Flory, Goodyear Tire & Rubber Co.
5. A New Structure for Micelles in Solutions of Colloidal Electrolytes and a New Type of Micelle
   W. D. Harkins, University of Chicago
6. Project Cirrus.
   I. Langmuir, General Electric Co.
7. Monomolecular Layers on Metals
   H. J. Trurnit, Medical Division, Army Chemical Center

Part II. *Biochemical Aspects of Colloids*

8. Interaction of Ions and Proteins
   I. M. Klotz, Northwestern University
9. Synthetic Polyelectrolytes
   R. M. Fuoss, Yale University
10. Interaction of Proteins at a Distance
    A. Rothen, Rockefeller Inst. for Medical Research, Princeton, N. J.
11. Structure and Reactions of Antigens and Antibodies
    D. H. Campbell, California Institute of Technology
12. Mechanism of Action of Certain Proteins
    A. H. Corwin, Johns Hopkins University
13. Toxicity, Isosterism, and Molecular Pattern
    W. Seifriz, University of Pennsylvania
14. Colloid Chemistry of Soil Solidification
    E. A. Hauser, Massachusetts Institute of Technology

GENERAL WAITT ADDRESSES SYMPOSIUM

Remarks of Major General Alden H. Waitt, Chief, Chemical Corps, at Colloid Symposium, Army Chemical Center, Maryland

Gentlemen:

I am very happy to be here to extend to you the greetings of the Chemical Corps and welcome you to this second symposium at the Army Chemical Center. I was out of the country when the Aerosol Symposium was held, a matter of great regret to me. Such meetings of scientists as these are of greatest interest and importance not only to the military, but I hope also to Science, and I desire to show by being present that I am fully aware of the importance, and that they have my enthusiastic backing, personally as well as officially.

This is really the third symposium sponsored by my Corps during the past year for we held one on Military Physiology jointly with the Medical Department at the Army Medical Center last winter.

We have been very fortunate in obtaining the cooperation of most distinguished leaders of science in the particular fields concerned in each case. This has guaranteed the success of the symposium and also has brought us new thoughts, new ideas, and greater stimulation to our own research program.

I confess that in sponsoring these symposia I am not entirely disinterested or solely concerned with science for science's own sake. There is a selfish interest for my own Corps and for applied Military Research.

We of course get the benefit of additional scientific brain power of the highest grade, brought to bear on subjects in which we are interested. That is, of course, apparent. But in addition we bring you here to see what we are doing, to get acquainted with us as individuals as well as with our problems. We have pride in our people and in our laboratories and sufficient confidence in our accomplishments to feel that your inspection will result in friendship and sympathetic understanding and, we hope, appreciation. We are confident that first class research work can be done under military direction and are willing to have you look us over and determine whether our confidence is justified. If you find that we are producing worth while results, that our scientists have freedom of operation, that they are not interfered with by those not fully competent in their fields, then this word will get around and we will find it easier to attract to our organization more of the highest type of scientists. I am proud of our organization but we need many more top flight research workers.

I know that in the past there has been some suspicion of government-controlled research. I want the Chemical Corps free from such suspicion. I want also to avoid any danger that our research staff becomes insular, or isolated, or self-satisfied. I want them in constant communication with the main stream of scientific thought. We must also be a lusty feeder into that main stream, not a quiet sluggish back water, and certainly not a trickle on a barren hillside that ends in a mud puddle that dries up when the first drought caused by political thoughtlessness comes along. That's another selfish reason for my interest in these symposia. They put us close to that main stream, and energize and stimulate our Chemical Corps scientists.

I am a firm believer in the importance of basic research to any balanced research and development program. We must carry our share of the basic research load. Of course that share can not be as great as in the case of the technical schools and universities since most of our funds must go to directed and applied research. Nevertheless,

(Continued on page 7)

The Membership Campaign

By LT. COL. ELLIOTT MORRILL, *Cml. Res.*
Vice President, Chairman Membership

During the past three years I have observed the efforts that have been made to secure new members for our Association and I have observed these efforts both at the level of your National Headquarters and of the local Chapter. It is my feeling that a local Chapter can do a better job to secure new members and obtain renewals than a similar effort on the part of your National Headquarters.

To this end your Executive Committee has agreed to go along with me on a membership drive during the period October 1, 1948 and January 1, 1949.

I have written to each of your Chapter Presidents asking him if he would recommend to me the name of a willing worker in his Chapter who would work with me as a member on the Membership Committee, and shortly I will announce the membership of this Committee.

Your Executive Committee has seen fit to approve my recommendation that during the period of this membership drive your local Chapter will be reimbursed to the extent of 50 cents for each new member that the local Chapter secures, and $10 for each group member that the local Chapter secures.

I originally made this recommendation believing in two things. First, that the local Chapter should be reimbursed for the costs of a local membership drive on a "Pay-as-you-go" basis. Since the local Chapter is already credited with the sum of $1 of the annual dues of each member of the Chapter and the sum of $20 (prorated) for each group member in the Chapter, this plan will provide a means of not only securing new members for our Association, but will make it profitable to the local Chapter and provide a means of increasing the local Chapter's treasury. The second thing that this plan should do will be to arouse more interest in the activities of your local Chapter. An increase in membership of 100 per cent will make it possible for you to hold bigger meetings and a more varied scope for your activities.

Much has been said about membership, and it is a thought that occupies the attention to a large degree of the officers of any national organization. I do not believe that it is a job that the national officers of any organization can do alone, and I believe that it is one for the individual Chapters and the individual members—because herein lies our strength.

I will pledge to you all of my efforts to the very best of my ability to do my end of the job. I will keep you informed, through the medium of your local representative on the Membership Committee, as to just what I am doing and as to the progress we are making.

All I ask you to do is each and every one of you to secure one new member, either an individual or group, and to support the efforts of our membership drive.

Symposium

(Continued from page 6)

we can and do justify a considerable program of basic research, fundamental exploration at the boundaries of scientific knowledge, which will eventually result in discoveries that can be applied by our engineers. In the field of colloids, the subject of the present Symposium, some of this basic work is being done either by contract or here at the Chemical Center.

Finally, just a word about the future, which at the moment looks so unhappy and dangerous. Our best chance for a peaceful future lies in being so well prepared to defend ourselves that no hostile power will dare to challenge our way of life. Our greatest strength lies in our science. You have heard these two statements many many times. Perhaps you are tired of hearing them. Nevertheless, they are true and most significant. If we are to be prepared we must be prepared ahead of time—and time is running out rapidly. If our strength lies in our Science, then there must certainly be a close alliance between the Military and Science, and a mutual understanding between the two. The Chemical Corps has constantly sought to strengthen this alliance and to bring out the understanding. It is perhaps the most important result of all to be gained by our Symposia.

We must work together and get to know each other now so that we can be well prepared and thus avoid war. But if war comes our joint effort will make it possible to bring the newest weapons to bear on an enemy in the shortest time and provide for our people the defensive equipment required to protect themselves.

I propose that my officers shall learn to work effectively with scientists so that in a future crisis they will know their way in the complexities of the scientific world, and I appreciate the opportunity which this Symposium offers to further my policies.

"Exercise Yukon"

By EDWARD C. BINGHAM, JR., *Captain, CmlC*

Air-transported infantry troops can operate effectively under average Alaskan winter conditions when properly equipped. The most logical attack to be used in the Arctic is a chemical attack since only chemical attack would assure the attacker the future use of existing shelter which is so essential for successful Arctic operations. Chemical Corps weapons, munitions, and equipment generally functioned better than expected under average Alaskan winter conditions.

These were some of the conclusions reached last winter by Chemical Corps observers who were present on Army Ground Forces "Exercise Yukon" in Alaska from November 1947 to March 1948.

The Chemical Corps observers, who represented the Chemical Corps Board, were Captain John Puskar, a combat veteran who served with the 2d Separate Chemical Battalion in Sicily, Italy and Southern France, and the author, Captain Edward C. Bingham, Jr., a former Instructor of Chemistry at the Agricultural and Mechanical College of Texas.

"Exercise Yukon" followed as the natural successor to "Task Force Frigid," which operated at Fairbanks, Alaska, during the extremely severe winter of 1946-47 to provide further training of troops in Arctic dry-cold. The general objectives of the Exercise were to develop air-transportability and airfield defense methods for the Arctic and to develop training and indoctrination methods, doctrine, tactics, technique and organization for future Arctic operations.

The Exercise was an air-transported maneuver conducted in Alaska by four successive augmented rifle companies of the 2nd Infantry Division of Fort Lewis, Wash., rotated to Alaska, for one month each, during the period 1 November 1947 to 1 March 1948, and supported by a troop carrier group of C-82 Fairchild Packets or "Flying Boxcars."

Exercise Based at Big Delta, Alaska

The Exercise was based at Big Delta, Alaska, a remote airfield in central Alaska on the banks of the Delta River, close to the foothills of the towering Alaska Range, about 80 air miles from Fairbanks. Close to Big Delta, the Alcan Highway from Canada joins the Richardson Highway which runs down to Valdez on Prince William Sound, with the Glenn Highway branching off at Glen Allen and running to Anchorage. Fairbanks is about 100 miles from Big Delta over the Richardson Highway and Anchorage is about 340 miles distant via the Richardson and Glenn Highways. The only habitation near the Big Delta base consists of a small village of about a dozen log houses, a relay station on the Alaska Communications System manned by a few soldiers, a group of about ten frame homes housing the CAA personnel who operate the weather station, and a few homesteaders' cabins scattered along the highways.

The author, CAPTAIN EDWARD C. BINGHAM, JR., Cml C, dressed in Arctic garb.

Organization of "Ucon" Companies

Each of the augmented rifle companies participating in the Exercise, referred to as "Ucon" Companies, was augmented to a total strength of 250 by various elements of the Infantry Division so that all components of the Division could be tested in the Arctic. The additional units added to the normal rifle companies included heavy machine gun platoon, tank platoon, 75 mm. recoilless rifle platoon, 81 mm. mortar platoon, Engineer platoon, Medical platoon, 105 mm. howitzer battery, ammunition and pioneering platoon, intelligence and reconnaissance platoon, counterfire squad, and 4.2-inch chemical mortar platoon.

Pre-Arctic Training

Immediately preceding its month of training in Alaska, each Ucon Company received a month's indoctrination and pre-Arctic training at Ranger Creek Camp, a rehabilitated CCC Camp located in the Snoqualmie National Forest high in the beautiful Cascade Mountains in the foothills of majestic Mt. Rainier, about 70 miles from Fort Lewis. While we were being "indoctrinated" for our Arctic adventure, along with Ucon "A" during the month of October, the training appeared to be more appropriate for preparing us for Peruvian mountain climbing during the rainy season. We were continually plagued by torrential rains which too frequently inconsiderately trickled through our Arctic tents and into our sleeping bags in the wee hours of the night. At no time during our stay were proper snow conditions available for the required preliminary training with specialized Arctic equipment. The succeeding maneuver elements, however, did receive valuable pre-Arctic training at this mountain "resort." Despite the unfavorable weather which was encountered during October, all concerned agreed that the training program of mountain climbing had resulted in excellent physical hardening although at the moment some muscles appeared to be softening under the process rather than hardening.

Air Lift to Alaska

The training of all Ucon Companies in Alaska generally followed the same pattern. The first week of the training period was usually consumed by the air lift of the company from McChord Field (near Tacoma), Wash., to Big Delta, Alaska, via Great Falls, Mont. Besides the 250 officers and men of each Ucon Company, 30 observers, baggage, weapons, dummy ammunition and emergency rations, heavy equipment such as a "Weasel," ¾-ton truck, jeep and trailer and a light observation airplane was also carried in the gigantic "flying boxcars." It is interesting to note the enviable safety record of the troop carrier group during the Exercise. In all air lifts, including those performed in Alaska, in which over 1,500 personnel participated, the group flew approximately six million passenger miles without a single fatality or serious mishap. There were a few exciting emergency landings during which it is reported new time records were established in buckling on parachutes.

The second week of the training period was devoted to two or three-day tactical exercises in the vicinity of Big Delta to provide general acclimatization of the troops to Alaskan terrain and weather conditions.

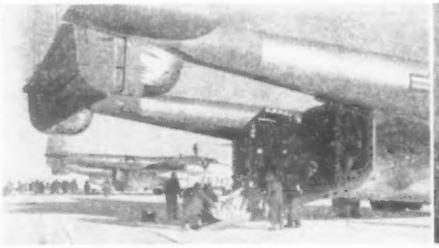
Arctic Clothing

All personnel participating in the Exercise received their Arctic issue of clothing before their pre-Arctic training. We bundled ourselves up against the cold in the following thirty-pound load of clothing: part wool underwear; three pairs of wool socks, including a lightweight cushionsole wool sock next to the foot and two pairs of heavy wool ski socks in graduated sizes over these; wool OD shirt and trousers; high neck wool sweater; cotton OD windproof, water-repellent overtrousers; pile-lined jacket; Arctic parka, consisting of pile liner and outer heavy cotton shell with hood with deep, fur-fringed ruff; one of three types of footgear, shoepacs for cold down to zero, felt boots for cold between zero and minus 20, or mukluks, with felt socks, for cold below minus 20; cotton OD cap with earflaps, or pile cap with earflaps; and leather shell gloves with wool inserts, or heavy leather shell Arctic mittens with two pairs of wool inserts. Some new designs of Arctic clothing were also used.

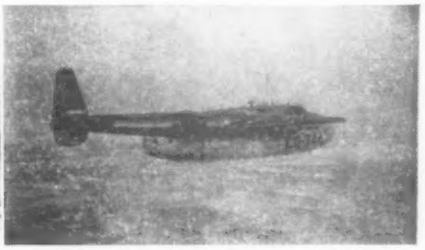
Field Living

In the field the troops operated, generally, in five-man groups which practice was dictated by the fact that the Arctic tent has a capacity for five men. The individual and unit equipment for each group was hauled by four men on a sled which could be easily converted into a toboggan. The load carried on each sled generally totaled

"Ucon" soldiers moving heavily loaded sled over rough terrain at Nome, Alaska. The Bering Sea can be seen in the distance. *(Photo by U.S. Army Signal Corps)*



"Ucon" soldiers loading their equipment into giant C-82's at Nome, Alaska. *(Photo by U.S. Army Signal Corps)*



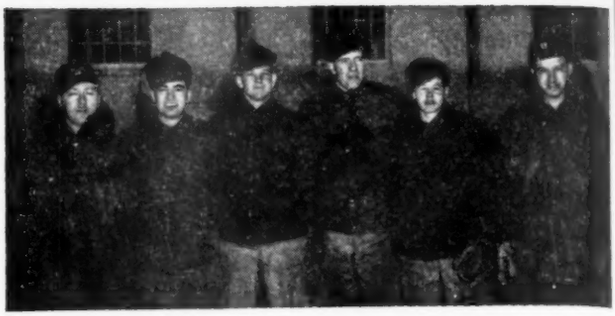
C-82 Fairchild Packet or "Flying Boxcar" as used in Exercise Yukon, in flight over Alaska. *(Photo by U.S. Army Signal Corps)*

about 400 pounds and included the lightweight pyramidal Arctic tent, "Yukon" gasoline-fire stove, 5 gallons of gasoline, field rations, snowshoes or skis, sleeping bags and extra clothing. Everyone lived very comfortably in the field in the tent, heated by the stove. The various types of field rations used, "C," "C-2," "E" and "5-in-1," were very adequate and provided the troops with hot meals so necessary in the cold. Water supply was provided by melting snow or ice and was not always adequate.

Airfield Defense Exercises

During the third week of the Alaska training period each Ucon Company was ordered by the Commanding General, U. S. Army, Alaska, to move out to defend some airfield in Alaska from an "enemy" airborne attack. Ucon "A" and "C" were ordered to Galena Air Force Base, located on the Yukon River in Central Alaska about 300 miles from Big Delta. Ucon "B" was ordered to McGrath Air Force Base, located on the Kuskokwim River in Central Alaska about 300 miles from Big Delta. Ucon "D" was ordered to Nome Air Force Base, located on the southern extremity of the Seward Peninsula on Norton Sound of the Bering Sea about 600 miles from Big Delta.

On "D-Day" of the airfield defense exercise, a squadron of C-82's, which was based at Elmendorf Field (at Anchorage), Alaska, arrived at Big Delta and picked up the Ucon Company. The Company was combat equipped with weapons, dummy ammunition, loaded sleds and a few vehicles. The air movement to the airfield to be defended was tactical with the transports receiving air cover from a P-51 fighter squadron, and on one occasion from a P-80 jet fighter squadron. In no cases were the transports allowed to remain on the ground for longer than one hour to avoid starting difficulties in the cold. Generally, landing, loading or unloading, and takeoff of each plane required less than one-half hour. Whenever weather conditions permitted, the transports followed the established troop carrier tactical technique of flying in formation at a low altitude of about 500 feet. Flying at low altitude as we often did, although sometimes hard on high blood pressure, afforded us a rare opportunity to obtain a close-up picture of Alaskan terrain.



Chemical Corps test personnel at Big Delta, Alaska. Left to right—Capt. John Puskar, T/5 Robert E. Duston, T/5 Charles M. Ellis, M/Sgt. Carl R. Peterson, T/5 Howard M. Thomas and Capt. Edward C. Bingham, Jr.

Upon reaching the airfield to be defended, the troops unloaded the aircraft as rapidly as possible and moved out by subordinate units to perimeter defensive positions which had been previously determined by the Company Commander by map reconnaissance. The troops bivouacked in the defensive areas, established outposts and sent out patrols to secure the defensive positions. An "enemy" paratroop attack, simulated by the dropping of parachute dummies from a single C-82, was made against the defended airfield. This attack was preceded by a simulated strafing attack of the field and defensive positions by fighter aircraft during which the Air Force aptly demonstrated their ability to fly very close to the ground. The attacking force, represented by an "enemy" detail, was always assumed to be a company similar in strength and armament to the defending one. The Ucon Company maneuvered against the "enemy." It was during this phase of the Alaskan training period that the most important lessons regarding operations in the Arctic were learned.

Weapons Firing

The final week of the Alaskan training program was devoted to platoon problems and field firing of all weapons possessed by the companies on the range at Big Delta. Unfortunately for testing purposes, but fortunately for the participants,

Bivouac at Nome, Alaska, during Exercise Yukon. *(Photo by U.S. Army Signal Corps)*

"Ucon" soldiers eating a dinner of "C-2" rations in their Arctic tent, heated by gasoline-fired "Yukon."

4.2-inch Chemical Mortar emplaced in snowbank at Nome, Alaska, during Exercise Yukon. *(Photo by U.S. Army Signal Corps)*

during all field firing the temperatures encountered were rather mild, with the thermometer registering above zero. All weapons appeared to function normally.

Motor Vehicles

The motor vehicles used on "Exercise Yukon," which were relatively few in number because this was an air-transported infantry maneuver, operated reasonably well at temperatures encountered with only usual starting difficulties. The "Weasel" (M29C Cargo Carrier) was the only vehicle which was used extensively, and the only one which was used cross-country. The vehicle appeared to be very satisfactory within its weight-carrying or towing limitation of about one ton.

All vehicles were "winterized" to include the installation of an enclosed cab, a gasoline-fired personnel heater and a standby engine heater. The standby engine heater is gasoline-fired and heats the engine coolant and circulates it through the engine and around the storage battery while the vehicle is not in use. Denatured alcohol was added in small quantities to the gasoline tanks of all vehicles to prevent formation of ice in the gasoline from condensate moisture.

Chemical Corps Participation

Chemical Corps participation in the Exercise was rather limited; however, the opportunity was afforded to obtain valuable needed information relative to Arctic operations. The participation of Chemical Corps personnel was limited to the presence of the two observers during the entire period of the Exercise and the inclusion in Ucon "D," which trained in Alaska during February, of a 4.2-inch chemical mortar "platoon" of two mortar squads from the 91st Chemical Battalion of Fort Lewis, Wash. The only Chemical Corps materiel used directly on the Exercise was smoke shells fired from the 105 mm. howitzer and smoke and HE shells fired from the 4.2-inch chemical mortar.

Cold Weather Tests of Chemical Corps Materiel

During the period of the Exercise, but independent of the Exercise, the Chemical Corps observers conducted cold weather tests on selected Chemical Corps items, assisted by M/Sgt. Carl R. Petersen, T/4 Paul Aronin, T/5 Robert E. Duston, T/5 Charles M. Ellis and T/5 Howard M. Thomas of the 266th Chemical Service Platoon from Fort Richardson (Anchorage), Alaska. Obviously, the results of the tests cannot be discussed in detail here; however, suffice it to say all items performed under Arctic conditions better than expected. Some previously formed opinions regarding the expected performance of chemical munitions were shattered by the results of these tests. Certain modifications must be made to our materiel to make it more easily operable while wearing heavy Arctic clothing, particularly mittens, but this problem also confronts most other technical services. The potentialities of chemical warfare in the Arctic are far from limited. As pointed out at the beginning of this article, chemical attack is a logical form of attack to be used in the Arctic because thereby the attacker will be assured the future use of existing shelter which is so essential for successful Arctic operations. No other form of attack will offer such assurance.

Weather Conditions

One of the first questions which was asked me upon my return from Alaska was, "How cold did it get?" Therefore, for no good reason, I've left discussion of the weather for the conclusion of this article.

The weather encountered by "Exercise Yukon" was mild in comparison with the extreme conditions which were encountered by "Task Force Frigid" at Fairbanks during the record winter of 1946-1947. I soon learned not to mention our "warm" weather in writing to friends in the States after receiving letters from my wife who spent the winter in Vermont describing her "Arctic" experience in prolonged periods of 30 below weather there. In order to be able to vindicate myself upon my return when the truth would out, I made a very careful study of Alaska weather records over the last twenty years. From this study, I learned that the weather which we encountered was very close to average Alaskan winter conditions.

We were surprised by the fact that Alaskan winter weather is one of extremes and not one of continued cold as generally presumed. The highs and lows encountered during our "visit" were plus 50 and minus 16 in November, plus 35 and minus 18 in December, plus 45 and minus 34 in January, and plus 38 and minus 36 in February. Although Big Delta is located deep in the heart of Central Alaska, where the air is usually calm, high winds were prevalent there, due to the location of the nearby mountains. Winds of 20 miles per hour were not uncommon, and winds up to 50 miles per hour were encountered occasionally. On one windy day it took an L-5 (Piper Cub) observation airplane approaching Big Delta, at full throttle, 25 minutes to cover the last 12 miles to the airfield.

A meteorological phenomenon of Central Alaska, which was noted upon study of weather data collected at Central Alaska weather stations

other than Big Delta, is temperature inversion of a marked degree. This is of particular interest, since it will be remembered that inversion conditions are the most favorable for use of gas and smoke. From these data it was found that temperature differences of as great as 30 degrees warmer would exist in air at 1,000 feet altitude from air at ground level. This marked inversion did not exist at Big Delta because of the prevailing high winds which mixed the warmer upper atmosphere with the ground air. This mixing of air resulted in the temperatures at Big Delta being, on the average, 10 degrees warmer than at Fairbanks, 100 miles away.

The maximum snow depth at Big Delta was 5½ inches and frequently the terrain was barely snow-covered. However, at the other places in Alaska where the troops maneuvered, deep snow conditions were encountered, such as 24 inches at McGrath, 19 inches at Galena, and 34 inches at Nome. It is interesting to note that Permafrost, which generally exists throughout Central and Northern Alaska, does not exist in the Big Delta area. Underground temperature readings made during the maneuver period showed that, even during the severest weather, the ground below a depth of six feet was not frozen.

Conclusion

As mentioned above, "Exercise Yukon" proved that air-transported infantry troops can operate effectively under average Alaskan winter conditions when properly equipped. Notwithstanding, the following thoughts of the noted Arctic explorer, Sir Hubert Wilkins, on the personnel problem involved in Arctic operations as contained in the Office of Naval Research pamphlet, "Across the Top of the World," should be considered:

"The modern soldier or sailor, ordered to duty in high altitudes, is not faced with the horrors of starvation or disease, such as scurvy, which dogged those who earlier in history ventured into northern areas. On the other hand, he is not buoyed with the spirit of adventure, the romanticism of sport or discovery, or the impelling desire to conquer the elements—attitudes which have sustained many of the explorer spirit during physical inconveniences and hardships.

"The modern service man knows that he will not receive high monetary reward for personal achievement, or individual publicity. His job is routine and compulsory. In all but a few instances he will not come in contact with the cheerful Eskimos, who by their attitude and example exhibit friendliness of the Arctic, which is friendly to them because they know and understand it. The establishment of friendship requires knowledge and comprehension, which a newcomer takes time to acquire."

My closing thoughts can be best summarized by a statement from the War Department Manual (TM 1-240), "Arctic Manual," and a comment by Vilhjalmur Stefansson, the Arctic authority, in his book, "The Arctic in Fact and Fable." The "Arctic Manual" states:

"The Arctic region is neither forbidding nor inhospitable. Because of the exaggerated stories of some explorers, it has acquired in the minds of many people a wholly undesired reputation for unlivability. White men settled in the Arctic 500 years before the time of Columbus. And continuously during the last 275 years, resident managers of the Hudson's Bay Company have lived in contentment at permanent posts, many of which are in isolated places. As for the native peoples, scattered evidence suggests that they may have made their first appearance in the North American Arctic as long ago as 20,000 or 25,000 B.C. At present the Eskimos are perfectly happy without most of the articles that are considered essential to civilized existence. These people are not an inferior race. Within the limits of their resources, they have learned to live in the Arctic more successfully than many so-called civilized people in less rigorous climates."

Stefansson comments: "The Arctic cannot be too cold for human habitation in winter, for if it were, a number of our forty-eight States would be uninhabitable; * * *."

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Some Army Policies and Their Application to the Chemical Corps Technical Command

By DUNCAN MACRAE *and* L. WILSON GREENE
Technical Command, Army Chemical Center, Md.

The unclassified document entitled, "War Department Research and Development Program, Fiscal Year 1949," published in July 1947, sets forth the broad policies governing research and development by the Army. It may be of interest to members of the Association to learn what some of these policies are and how they are being followed by one of the research and development organizations of the Chemical Corps. Policy quotations from the document referred to above are given in italics.

Development programs will, in general, be based upon the reported needs of the eventual using organization. The needs of the using services, in the field of chemical warfare, are reported to the Chemical Corps Technical Committee. The General Staff, on recommendation of the Technical Committee, approves military requirements and these requirements are then listed in the Chemical Corps Book of Standards. This book shows at all times those needs and the items which have been standardized to fill them. When no item has been standardized to fill a requirement, or when the standard item is not satisfactory, development projects are included in the Chemical Corps Research and Development Project Program. Research projects are undertaken to explore the possibilities of developing new types of chemical agents, weapons, ammunition, protective devices, and other military equipment, and techniques for their use. These research projects are investgated in the laboratories of the Chemical Corps and are supplemented by research contracts with university, industrial, and government laboratories.

There has been considerable discussion from time to time as to the proper differentiation between a research project and a development project. We agree with Admiral P. F. Lee, Chief, Office of Naval Research, that a research project results in a report, while a development project is expected to yield an end item or a military technique.

All projects for which the Chemical Corps is responsible are listed in its Project Program. This program gives the reason for each project and tells who requested it. It is being revised constantly, and projects are added or dropped as circumstances require. Among the agencies which conduct this continuous review are the Research Council; the Chemical Corps Board; the Supply and Procurement Division; the Plans, Training and Intelligence Division; the Air Chemical Officer; and the Field Chemical Officer.

Vigorous attention will be paid to the development of new techniques for the use of new weapons and equipment. When new weapons and equipment are ready for service tests under the supervision of the Chemical Corps Board or other service board, instructions for the care and use of such materiel are supplied to the board. One of the purposes of the service test is to determine if the techniques covered by the instructions are suitable for use by soldiers in the field. A further purpose is to develop suitable techniques where required.

A minimum of expense and effort will be employed to improve existing conventional weapons and equipment. A review of the 1948 Project Program shows that the major part of the effort of the Technical Command is directed toward the development of new items. It is, however, necessary that a considerable number of important improvements on conventional items be completed in the near future. A recent study indicates that within the next five years a considerable proportion of our development projects will be completed, and work on entirely new end items can

Major General Alden H. Waitt, Chief of Chemical Corps, Department of the Army, presenting the Bronze Star Medal for heroism in action to 1st Lt. George W. Connell, Jr., on August 13, 1948, awarded pursuant to G. O. 51, dated July 20, 1948.

be undertaken. Thus, it should be possible to reduce still further the relative effort on the improvement of conventional weapons and equipment.

The fullest utilization by the Army of the civilian research and development resources of the nation can not be procured merely by prescribing the military characteristics of certain types of equipment. New and unsuspected contributions to the development of the Army are more likely if detailed directions to scientists and industrialists are held to a minimum. The research and development agencies of the civilian economy will be familiarized with the fundamental problems of the Army. This applies to research pertaining to tactics, strategy, and techniques as well as to research leading to new materiel. The Technical Command recommends to its consultants and contractors and to those who are teaching our civilian and military personnel in universities that they study the unclassified War Department Research and Development Program for 1949. In addition, consultants and contractors are invited to visit the Army Chemical Center to discuss problems in their fields with members of the Command who are most familiar with these problems. In this way we hope to have some of the best qualified scientists in the United States become familiar with certain of the fundamental problems of the Army. The members of the American Chemical Society Committee Advisory to the Chemical Corps are among our most helpful consultants. Another helpful group is called the Research Council of the Chemical Corps Advisory Committee. It is composed of outstanding scientists in the fields of chemistry, biology, medicine, and engineering, and with its several panels is more thoroughly informed than any other civilian group concerning the fundamental problems of the Army in the realm of chemical warfare.

Research and development agencies of the Army will utilize to a maximum, on contract basis, civilian educational institutions and industrial laboratories for the solution of problems within their scope. Of the total number of Technical Command research contracts, approximately half are with universities and the remainder are with industrial and government laboratories. It is not definitely established at this time as to the amount of funds which will be available for research contracts in the Fiscal Year 1949. In general, all funds available above those necessary to maintain a technical organization employing about 700 people with its necessary facilities are used for financing research contracts.

Army research and development agencies will foster close research relationships with educational and industrial agencies to supplement Army research facilities and to keep them acquainted with Army problems so as to more quickly make use of their discoveries where they will apply to Army development requirements. The Technical Command depends principally on the American Chemical Society Advisory Committee, the Research Council, and individual consultants to keep it advised as to new scientific discoveries applicable to Chemical Corps problems. Scientists and engineers of the Technical Command of course keep abreast of scientific progress reported in the literature.

Scientific talent available within the military establishment will be augmented by the rotation of selected scientists within research and development agencies, by the offering of new positions to scientists, by the maximum freedom of opportunity for civilians, and by appropriate salaries for those personnel working directly or indirectly for the War Department (Department of the Army). The Technical Command has under consideration a plan whereby selected scientists who are leaders in the basic sciences of interest to the Command can be invited to spend from three months to a year at the Army Chemical Center, using our library and facilities for research, and becoming thoroughly familiar with our problems in their respective fields. We have already begun to send some of our professional men abroad for extended visits to scientific and technical establishments. One of our men has just returned from a year at Northwestern University, during which time he worked on a research contract and completed work leading to a Master's degree in chemical engineering. Another man is at Stanford University working on a research contract for which he will get credit toward a post-graduate degree.

Plans are in an advanced stage for the establishment of a graduate school at the Army Chemical Center in cooperation with the University of Maryland. This will increase the freedom of opportunity for professional advancement for employees of the Technical Command. Professional employees of the Medical Division and other agencies at the Army Chemical Center will have an opportunity to attend this graduate school.

Technical Command employees are encouraged to present papers at scientific meetings and to publish the results of their work, provided that release of such information is consistent with national security. In the last fiscal year, our professional employees published about thirty-seven research papers and articles, completed

more than twelve inventions, and were granted two United States patents.

The scientific laboratories of War Department research and development agencies will be utilized primarily for the solution of peculiarly military problems in the field of applied research and development. There is little question that our facilities are used primarily for military purposes and will continue to be so used. However, we have in our organization scientists who can and do contribute to the fundamental knowledge on which the work of the Chemical Corps is based. A certain amount of pure research is necessary to promote the professional development of our technical personnel and to keep our scientists and engineers in a position to appreciate recent advances in scientific knowledge so as to apply them to military problems.

Priorities for the utilization of research and development funds are established as follows:

Priority 1—Payrolls for government personnel whose services will be carried over into the next fiscal year.

Priority 2—Funds for the purchase of supplies and equipment for the profitable employment of the above personnel.

Priority 3—All contracts except those which require the construction of pilot models.

Priority 4—Contracts for the construction of pilot models; the purchase of new materiel and equipment, and other such charges.

This means that expansion and contraction of appropriations must be taken up largely in expansion and contraction of the research contract program.

Everything possible will be done to achieve stability of employment for qualified civilian scientific and technical staffs engaged in research and development activities in the Army. As indicated above, this means that variation in appropriations is reflected principally in the amount expended for research contract work. However, the Technical Command is not satisfied merely to achieve stability of employment. It is concerned with attracting promising young scientists and engineers to its staff, promoting the professional development of its employees, and creating an atmosphere highly conducive to the best scientific and engineering work.

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They Couldn't See Down Into the Valley

By HOUSTON C. JOYNER, *Lt. Col., CmlC*

Between 6 and 17 January 1945, the 85th Infantry Division, under the command of Maj. Gen. John B. Coulter, was engaged in relieving the 1st British Division in the mountains south of Bologna, in the Sillaro Valley sector. On the right, the division assumed defensive positions in Frassineto and manned a line of trenches and bunkers west along Cerere Ridge and on the eastern slopes of Monte Grande. On the left the division defended the western slopes of Monte Grande and Monte Calderaro, and extended along the Cuccoli Ridge west of Marzolina.

The British 78th Division was the adjoining division on the right. Monte Castellaro and Mezzano, north and northwest of Monte Grande, respectively, had been captured originally in October 1944 by the 85th Division, but were now in enemy hands. The long Calderaro Ridge, jutting north from Monte Grande, was now the most advanced position on the Fifth Army front. Monte Grande and Monte Calderaro dominated the enemy territory immediately to the front, and provided the Allies with observation of the Po Valley. From the heights of Monte Castellaro, Monte Merlo, and Vedriano, the Germans were able to see well into the Division's territory and could place observed fire on a considerable part of the main supply route to the front. The enemy unit facing the 85th was the 1st Parachute Division, by reputation one of the best German Divisions in Italy. This division so gallantly defended Cassino.

The region was more difficult than any part of the Appennines which the division had yet traversed. The soil was nearly barren, the growth sparse and puny. The hills crowding the valley were wasted by erosion. In winter the steep sides of the hills were either covered with snow or mud. The troops in reserve and rear installations found few buildings in which they could take shelter. Even the few which were still standing were damaged by the war which had not yet passed. Consequently the bivouac areas for a considerable number of the American and British troops had to be located in the Sillaro Valley, to the rear of San Clemente.

The sector was poorly served by roads. The Sillaro Valley Road was used as the MSR by both

LT. COLONEL HOUSTON C. JOYNER, CML.C.

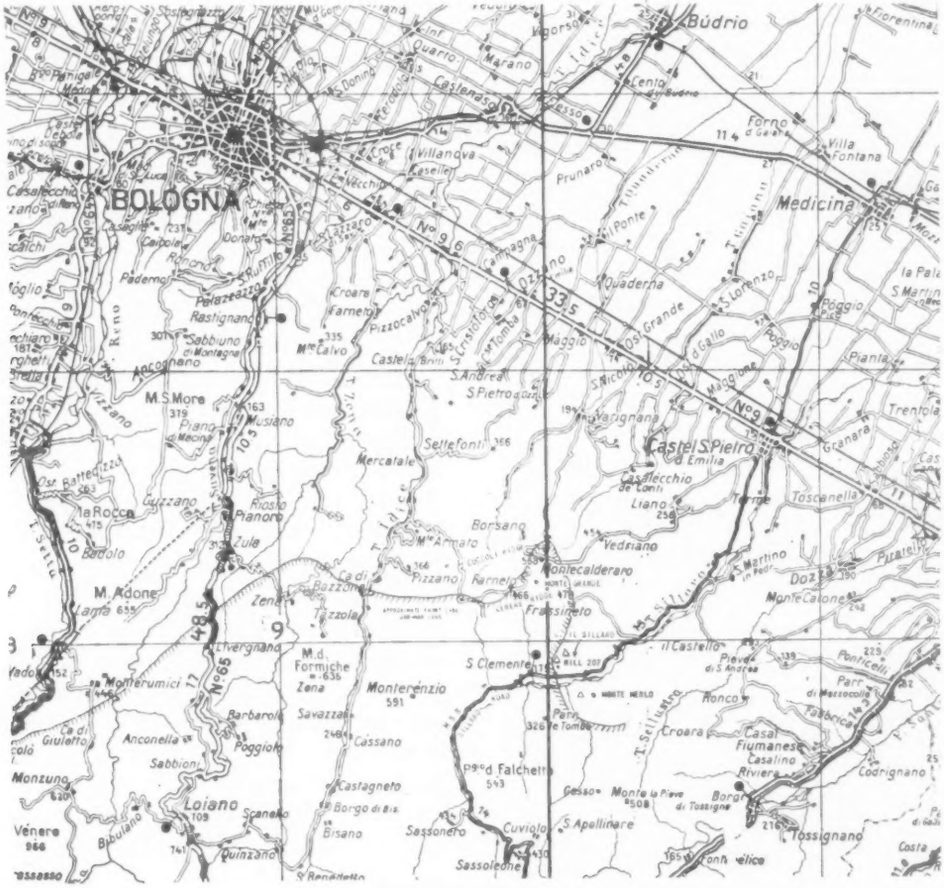
the American and British troops. It had been provided with a good drainage system by the British troops who formerly held the sector and was adequate for the division motor traffic, as far as it went. To the north of the Sillaro River, only a few trails ascended the ridges and mountains where the 85th held its main line of defense. Until wooden and metal ramps were used, these trails were not even suitable for mules. As time went on, however, some trails were widened and reinforced to permit the passage of jeeps. The Boston Byway pushed north from San Clemente, the Assian Way taking up where the Boston Byway left off. The Western Valley Road also extended north from the Sillaro Valley Road.

Through January and February, this front was covered with snow, not more than a foot deep in most places, but in the ravines and other depressions where the snow drifted, it was frequently more than waist deep. Intermittent rain and hail often caused the roads to be covered with ice, and in general made living at the front a difficult task.

During the two months the division held this line, there were, however, many clear days. During the first fifteen days of March, for example, there was not an overcast day, and visibility ranged from six to twelve miles.

The most vital and vulnerable point in the Sillaro Valley was the crossroads at San Clemente, and the 88th Infantry Division had screened this intersection with M1 smoke pots soon after its capture in October 1944. The following month the sector was turned over to the British 78th Division who expanded the screen and employed three officers and eighty enlisted men. Brigadier Reid (RCA) considered that screening was the 78th's most important mission while on the defensive in that area. Both the Americans and the British had a number of artillery positions, tanks and bivouac areas in the sector, many of which were under the direct observation of the Germans —except for the screen. Unfortunately, the HC smoke from either the American M1 or the British No. 24 pot generally produced nausea, headaches and coughing among the troops subjected to the smoke for a period of time.

On January 22, 1945 Lt. Gen. Lucian Truscott, Fifth Army Commander, and Maj. Gen. John B. Coulter inspected the front lines in the vicinity of San Clemente. Gen. Truscott requested that the smoking operation be performed by the use of mechanical generators. It was also requested that the British Eighth Army transfer control of the operation to the Fifth Army, which was more experienced in mechanical smoke screening. Both armies were concerned as the screen was vital to all troops in the area. Consequently, the following day a conference was held between the British and American officers to make arrangements for the transfer of control. Among the American officers present were Col. Walter Guild, Fifth Army Chemical Officer; Lt. Col. Houston C. Joyner, 85th Infantry Division Chemical Officer, and Lt. J. P. Petrocelli, platoon leader from the 172d Chemical Smoke Generator Company. British officers in attendance were Lt. Col. Bolwater, representative for Brigadier Reid, RCA, British 78th Division, and Lt. P. C. Fuller, platoon leader in charge of the smoking platoon. As written orders had not been issued for the transfer, the British were reluctant to make the change in operation until they were convinced that the smoke generators were more efficient than the smoke pots.



SAN CLEMENTE AREA

Scale 1:100,000 0 5 10 Miles

On 24 January thirty enlisted men from the 172d Smoke Generator Company arrived in the area to make preparations for the smoking. Four days later, a demonstration of the M2 mechanical smoke generator was held for the British, and Brigadier Reid was among those present. The British were favorably impressed and beginning that same day five generators were employed on the smoke line in coordination with the British pots. The Chemical Officer of the 85th Division was then placed in direct supervision of the operation and the services of Lt. A. B. Perkins and ten more enlisted men of the 172d Smoke Generator Company were secured. Lt. Perkins commanded the platoon which operated the mechanical generators from this date, with the British, for the moment, manning and supplying the smokepot positions on the hillside. The transfer of the responsibility for the complete screening operation was delayed until sufficient American personnel were available for the smokepot positions. Additional enlisted men could not be obtained from the 172d Smoke Generator Company which had another smoke mission with the II Corps, so the 85th Division furnished the extra manpower for supplying and operating the smokepot positions.

On 10 February, the responsibility for screening the whole area was transferred by the British Eighth Army to the American Fifth Army. Under the Division Chemical Officer, the detachment of the 172d Smoke Generator Company was given the following mission, in this order of priority:

(1) To screen the ford at San Clemente, including the western approach to the ford and the ford road to San Clemente crossroads.

(2) To screen the MSR, Sillaro Valley Road, leading to San Clemente from the west. This included the junctions of the Western Valley Road and of the Boston Byway Road with the Sillaro Valley Road.

M-2 Smoke Generator in operation at crossroads, San Clemente position No. 2, February 26, 1945. Left to right, two smoke generator operators and Lt. Col. Joyner.

San Clemente, Italy. Smoking operation, 1600, 3 March 1945.

(3) To screen the artillery and tank positions of the American and British troops in the Sillaro Valley for two miles west of the ford.

The enemy OPs, which were to be denied observation, lay generally east of San Clemente, from two to four miles down the Sillaro Valley.

The smoke installations consisted of two separate smoke lines. The longer and more important line ran north and south, with the most northerly position (No. 2) behind a hill about 200 yards north of the San Clemente crossroads. In the beginning, only seven generator positions were established on this line, but the number was later more than doubled. The secondary line, about 2000 yards west of the first line, also ran north and south. It climbed the two hillsides which formed the gap just east of the junction of the MSR and the Western Valley Road. The secondary line of positions was necessary because, when the smoke hung low around San Clemente, the enemy was able to look over the screen and observe allied concentrations west of the Western Valley Road. The primary line consisted mostly of mechanical generator positions but the secondary line had only three generators employed.

The mechanical generators were placed in pairs so that if one became unserviceable the other would be immediately available. In case both generators became unserviceable, a supply of 50 to 75 smoke pots was available at each station. The chief reason for the gradual increase in the number of smoking positions was the frequent changes in wind direction and velocity induced by the rugged terrain. Usually

ten to fourteen stations were in operation at any one time, the number depending on weather conditions. Fog oil smoke from the generators had the advantage of not being disagreeable to personnel or animals passing through the screen or living in the area. This type of smoke also lay closer to the ground than that from the pots.

Generator stations replaced smoke pot stations wherever practical. There were, however, many locations on the smoke line where a generator could not be placed or supplied, on account of the rugged terrain and minefields, and at these stations, smoke pots were maintained. There were in all, eighteen smoke pot stations established. The number in operation at any one time, usually about twelve, depended on weather conditions, although at times all positions were in operation. Sometimes, in the gap, it was necessary to fire pots from the top of one mountain to the top of the adjoining mountain in order to maintain an effective screen. On the steep hillsides the large British smoke pots were more suitable than the small American M1 pots because they contained more fuel, burned longer, and were easier to open. In addition, they were more convenient to carry, whether by hand or by mule pack. Both types of pots, however, were employed throughout this screening operation. Frequently, the burning time of the pots was greatly decreased because of the strong wind on the mountain side.

As a rule, the screen was started about 30 minutes prior to daylight, in order to have an effective cover at that time. Otherwise, small areas of smoke drew mortar or artillery fire. When the screen became too heavy and interfered with traffic or artillery observation, some of the generators and pot positions were closed. Thick smoke had to be maintained where the MSR curved through the gap, so the division kept four men on duty at this point as guides and watchmen.

At all times an adequate supply of fuel oil, fog oil, gasoline, and American M1 pots were available. These supplies were furnished by trucks to the area by the Fifth Army Quartermaster transportation. Requisitions and daily expenditures of supplies were telephoned by the 85th Infantry Division Chemical Officer to the Fifth Army Chemical Officer daily. Usually convoys arrived every other day containing from 15 to 25 trucks. There were three large bridges between the Army Supply Point and the smoking area in enemy artillery range that were frequently shelled, so a 10-day supply level was maintained in case the bridges were destroyed. This required the establishment of 11 dumps as storage areas over several miles. With many British and American installations in the narrow

Smoking operation—San Clemente, Italy, 12 February 1945. A part of secondard smoke screen. At times it was necessary to smoke from the top of the mountain to this valley and up to the top of another mountain. To the right forward position was located tanks and artillery of the American and British forces. Smoke is from an M-2 Generator that was temporarily located at smokepot position No. 6.

valley, it was difficult to find sufficient flat areas for storage dumps. No buildings or cover was available. On account of the mud, these areas had to be near the road so as to be accessible. Four trucks of the smoke platoon made the distribution from the dumps to the generator and pot stations under the cover of darkness.

On 16 February 1945, two M2 generators were placed, during the night (No. 14 and No. 15 on the sketch) about 600 yards due east of the British forward positions. They were located with and in advance of the infantry. Their mission was to smoke every morning for about one half hour in preparation of a limited objective attack by the British to improve their positions and to cut off observation. After a few days' smoking, however, this attack was called off. The generator positions usually received machine gun fire while they were smoking.

Smoke pot station No. 16 was located in the river bed between smoke generators. The only means of supply to this point was by hand-carrying, because water and mud made it impracticable to supply this station by vehicles. The steep slopes, mud and minefields on both sides of the river also made difficult the supply of pot positions on the mountain sides. Supply had to be by hand or mule pack to these positions, most of which were on the secondary smoke line. On 8 February a landslide occurred at generator position No. 18, due to the river cutting away at the bank. This generator position was replaced by a smoke pot station, on account of it being impracticable thereafter to supply that point by truck.

The following tabulation shows the smoke expenditures in the San Clemente operation, under the 85th Division:

	Jan.	Feb.	Mar.	Total
Generator Hours	160	1,898	2,302	4,360
Fog Oil (gallons)	7,968	71,988	150,158	230,114
*Pots, British	206	4,376	3,462	8,044
**Pots, M1	0	750	3,118	3,868
Gasoline (gallons)	935	9,180	16,740	26,855
Fuel Oil (gallons)	870	8,741	3,569	13,180

NOTES: Various mixtures of fog oil and fuel oil were used depending upon the temperature. The normal ratio during freezing weather was four parts fog oil to one of fuel oil.

*This number does not include several thousand used by the British on special smoking missions in the vicinity, such as for protection of British maintainance road crews and mine detection personnel. All British smoke pots in the area were turned over to the American smoking personnel at the time of the transfer of control of the smoking operation.

**This number does not include approximately one thousand M1 pots used by other American troops for special missions in the area during the smoking operation.

A total of 44 generators were used on the smoking mission, which included replacements; of this number two were Navy Besslers. The M1 mechanical generator was not used on this mission.

Generators frequently became unserviceable after 100 to 150 hours of continued use. The main difficulty encountered with the operation of generators was with the M2 coils, of which a total of 55 were burned out during the mission, after being used for a total of 3054.5 hours. The average life per coil was, therefore, 55.5 hours. Undoubtedly, hard water was the cause of some of these coils becoming unserviceable so quickly. At times it was necessary to use water from wells and streams, as the water points in the area could not handle all the requirements. Flushing the M2 coils with hydrochloric acid had little effect.

Motors, fans and ignition systems also required constant maintainance. Frequently the diaphragm on the fuel pump became unserviceable for a short period of time. A jeep diaphragm served very well as a replacement when others were not immediately available.

The smoke troops of the 172d Smoke Generator Company had to be constantly on the alert in order to maintain the screen where and when it was needed. When there was a large foot troop or mule movement scheduled on the MSR through the smoked area, advance notice was given to the Division Chemical Officer, who passed the information down to the smoking personnel, and a heavier than usual concentration of smoke was maintained until the units had cleared the smoked area. When the British had operated the screen and conditions were unfavorable for effective smoking, only jeep and ambulance traffic was allowed through to pass the area. Observers were posted at strategical locations for checking the effectiveness of smoke. Also, aerial photographs were taken frequently during the operation to observe the efficiency of the overall screen. On account of the rugged terrain and valleys, there was no predominating wind direction. At the same moment, the wind direction in the Sillaro Valley, Western Valley and the Boston Byway Valley might be different. These conditions required continuous study and checking by observers to maintain an effective smoke screen.

One of the greatest difficulties in this smoking operation was maintaining a sufficiently high smoke ceiling. The terrain was such that the enemy, at times, could look westward over the screen and observe the rear areas where many artillery and tank positions were located. To prevent this, a reinforced smoke pot screen was established about a mile in the rear of the generator screen. Smoke would not usually rise prior to sunrise and also frequently between 1000 and 1600 hours. The use of an airplane spray of FS or FM smoke was considered to increase the ceiling of smoke in the Sillaro Valley. The plan was to have the plane fly down the valley every 15 to 30 minutes and release the smoke. As there were many installations and bivouac areas in the valley, higher authorities disapproved the plan because the screen might have been difficult to control and might have interfered with the operations of the front line troops.

Co. "B," 339th Infantry, 85th Division, march up to take positions in the line at S. Clemente, 17 February 1945. The scene is along the Boston By-Way about 200 yards north of the San Clemente crossroads. Enemy OP's are to the right down the Sillaro River Valley. The smoke shown here is produced by an M-2 Generator at Position No. 2.

To insure adequate control of the screen, telephones were installed to each generator position, to the forward CP of the 172d Smoke Generator Company platoon, and to the orderly room in the bivouac area. Radio communication was generally ineffective due to the "dead spots" in the mountains. Radios were used to advantage, however, on one occasion when the river was so high that some smoke positions were isolated and the telephonic lines could not be kept in repair.

Effective screening at all times required both forward and rear observers, each with good communications to the smoking stations. Besides these observers, gas officers in the front lines reported on the condition of the screen in their sectors.

The smoke troops and materiel were subject at any moment to mortar and artillery fire. Despite the lack of observation, the enemy fired shells into the area intermittently. Foxholes were dug at every position and the generators were so placed to have cover from enemy observation. The smoke troops were also required to wear helmets at all times. Uncleared mine fields were also a constant threat. On the night of 28 February propaganda shells landed in the smoking area, one shell striking less than a yard from a generator. Needless to say, the subjects of the propaganda leaflets were Churchill, Jews, Truscott, Wall Street and leaves for American troops. The total casualties in the 172d Smoke Generator Company during the whole operation was only two. Shortly after the British again took over the screen, however, two soldiers were killed and several wounded by shell fire.

The screening operation of San Clemente supported Allied operations against the Germans in several ways. Troops, on foot or in transport, and supplies were able to move along the MSR without the danger of enemy observation. The screen concealed American and British tank and artillery positions and seriously impeded enemy counter-battery work. Bivouac areas and supply dumps were also hidden from the enemy view. The low total of casualties among personnel of the 85th Division for January, February and March 1945 indicated that enemy shell fire was not effective. During the period 10-15 March, when the British 10th Indian Division was relieving the American 85th Infantry Division, the MSR through the area frequently carried two columns of foot troops, besides mule columns and vehicles. During this time, however, the smoke was so effective that, in spite of frequent shellings, there was not a casualty on the road.

The British, as well as the Americans, considered the screening necessary and effective. After relieving the 85th Division in mid-March, they continued to screen, first with the detachment from the 172d Smoke Generator Company, and later with their own troops employing Esso generators and British pots. Throughout the operation, the British were most cooperative.

As often is the case in war, the best evaluation of the effectiveness of an operation may be deduced from enemy action. Long range patrols were sent deep into Allied territory because the 1st Parachute Division wanted to know what was going on behind the smoke screen. These patrols were to observe movements and the volume of traffic, to pay attention in particular to the number and location of tanks and artillery positions, and to note the concentrations and identity of troops. A notebook found on one of the captured Germans revealed that, even when well inside the Allied lines near San Clemente, it was impossible to make accurate observations. The enemy patrol could not spot the artillery positions nor watch traffic on the road. All he could note was the continuous noise of motor movement. He could not see down into the valley—because of the smoke.

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Chemical Warfare in World War II

Little more than three years have passed since World War II was brought to an end. VJ-Day was the long-awaited signal for the American public to forget war, the campaigns in Europe and the Pacific, the "draft," the manufacture of planes, tanks, bombs, and flame throwers. It was the time to start thinking of new cars, houses, television, vacations and the other pleasures of peace.

During these three years the familiar khaki uniform has been replaced by the blue business suit and sport jacket; arm chair generals are now calculating baseball standings rather than front line advances, and lipstick manufacturers are again making lipsticks. War and its ramifications had been put back deep in the minds of everybody.

The peace, however, is not all that it was supposed to be. War clouds are again threatening. The touchy situation in Berlin, the unrest in Europe, the fighting in the Middle East and other places, and the failure to reach agreements with other nations has brought the thoughts of war out of the cobwebs and made them active again.

Congress is now appropriating billions more for national defense, the military establishment is drawing up strategic plans for military and industrial mobilization, the draft has again gone into effect and industry itself is becoming conscious of the needs for war mobilization.

Chemical warfare will undoubtedly again be an active part of the mobilization plans now being drafted. Reserve officers who were part of the Chemical Warfare Service, scientists who created much of the new equipment, and industrial firms which supplied the material and equipment to the service will again become active should mobilization become effective. In addition other groups which did not participate during the last war may now be called on to take part in the program.

This new trend of thought means that these groups will need to refresh their minds on the part chemical warfare plays in modern warfare. The organization of the Chemical Corps, its methods of operation, the items of procurement, and the new equipment developed by its scientists will all have to be rehashed.

"The Chemical Warfare Service in World War II" is a good refresher for those interested groups. This book, published by the Armed Forces Chemical Association, is a popular and concise version of chemical warfare during the past war. The volume contains information on the wartime records and achievements of the Combat and Supply units of the Service; the organization and the achievements and problems of research, development, procurement, and supply for incendiary bombs, biological warfare, ammunition, smoke, toxic gases, and flame throwers. The large number of illustrations of chemical warfare as it was actually waged also make the book of interest to the nontechnical reader who wishes to inform himself of this fascinating and highly important aspect of our military operations.

Though the activities of the Service are treated briefly in this volume, it will be found that no important phase of the Service's activities has been omitted. Some of the so-called "forgotten" men and units of the CWS receive treatment in this volume. The general reader is also given a much-needed picture of the non-gas mission and operations of CWS personnel and units in air and ground combat.

The volume certainly provides the general reader with an excellent account of the contributions of the Service in World War II and will give any reader a comprehensive view of the Service which is not available in any other published form.

Refresh your memory on the mission of the Chemical Warfare with your copy of "The Chemical Warfare Service in World War II." Fill in the coupon on the opposite page and get your copy immediately. Price is $4.

THE QUARTERMASTER REVIEWS OUR BOOK

The following interesting review of "Chemical Warfare in World War II" appears in the September-October issue of The Quartermaster Review. It is reprinted with their permission.

This report of accomplishments of the Chemical Corps is a nontechnical general reference work which includes a short account of the Chemical Warfare Service prior to World War II. It is an interim account of the accomplishments of this Service, details of which will in the years to come be included in a five-volume history of the Chemical Corps which will be a part of the Army's history of the United States Army in World War II. It should be of interest to all officers of whatever category who have interest in the Chemical Service, students of World War II and historians. It outlines several reorgani-

zations of the Chemical Service during World War II in order to keep in step with the changes in the organization of the War Department and the many changes and improvisations in the organization of the different Theaters of Operations.

One chapter is devoted to an interesting account of research and development which was carried on in collaboration with all manner of agencies, government, Army, Allied, civilian and numerous educational institutions. There is brought out that this activity was extremely necessary in order for the Chemical Corps to be prepared with a counter threat to the constant threat of gas warfare by our enemies. Nor was defense against biological warfare forgotten, on which the authors say, "The investigation of defense against biological warfare resulted in significant contributions to our knowledge concerning the development of the immunity in human beings and animals against many infectious diseases."

Because of the development of long-range bombers during the war, special attention was given by the Chemical Corps to civilian defense and defense against air attack which eventually led to the establishment of civilian protection schools in order to develop air raid defense leaders which could not be produced in the necessary quantity by the Army. It is well known that we still know little about adequate civilian defense.

In the chapter on "Readiness for Gas Warfare," the authors indicate that one of the most important factors in the non-use of gas warfare in World War II was the German knowledge of the state of readiness both offensively and defensively of the United States in this type of warfare.

The book concludes with the description of the different types of equipment and materials developed and used in various Theaters of Operations and some statistical information on Chemical Corps Units. W. A. P.

RESERVE CHEMICS MEET IN NEWARK

Meeting of the 182nd Organized Reserve Chemical Group and the 305th Chemical Base Depot Company, as well as Enlisted Chemical Corps Reserve, at Newark, New Jersey, on September 16th was addressed by Major Peerenboom, Chemical Corps School, on "Chemical Corps Organization," by Lt. Col. Chapman, Plans and Training Branch, Office of the Chief, Chemical Corps, on "Reserve Corps Training," and by Col. Kuhn, Chemical Corps, Retired, on "Industrial Mobilization Planning of the Chemical Industry."

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Civilian Defense

By T. H. McHATTON, *Col. Cml. Res.*

Now that Congress has finally coordinated the military establishments of the country under a Secretary of National Defense the time has arrived for Mr. and Mrs. Citizen to seriously consider the problems of civilian defense as a part of the new portfolio. With the front lines of any future war being moved into the nursery, unless there exists a well established and thoroughly organized system for the protection of city populations, there just won't be any war and a nation of freemen will become slaves at the flash of an atomic bomb.

The most vivid imaginations of the past never fully pictured the ruthlessness of the recent war. Man thought that barbarians were dead and would remain buried in history. Man was mistaken. The modern counterpart of these ancient monsters so refined cruelty and invented such death-dealing weapons that civilization now stands at the threshold of disintegration. Man will again be mistaken if he thinks this was the last war. The signing of peace cannot bind the world in love as long as some of these superbarbarians are motivated by the materialism of conquest.

It is suicidal for Mr. and Mrs. Citizen of these United States to become so engrossed in private affairs that they refuse to think of the possibilities that lay ahead. We must recognize that we are a democracy and "can't let George do it," for we are George. If the populations of our cities are to be protected it must be done by us, as we are the citizens that make up these populations and cannot shirk our responsibilities.

At the opening of World War II, military and other well-informed minds felt that some things were possibilities, but it was never really believed these possibilities would happen. Hitler's air forces made these possibilities established facts and the war was moved into the home. The world of today owes a debt of gratitude to the British civilians who put the home fires out while the boys were at the front. The British civilian defense was not an army matter; there was no army available when it was forced into action. Hitler's bombs dropped into the laps of the city officials, the police, fire departments, hospitals and ordinary citizens; these home organizations had to tighten up and fight or bear the German yoke of slavery. Thank God, they fought; only those well informed know how well they fought and how close they came to losing.

Colonel McHatton has had a broad experience as a Chemical officer in the field of Civilian Defense. He served on the staff of the Civilian Defense School operated at Edgewood Arsenal in the early days of the war and later headed up the Civilian Defense School established at the University of Maryland. In this article he does not discuss the problem of a Civilian Defense program in connection with a future emergency situation from a technical level. Rather, he orientates the reader as to the reality and nature of this problem, which may presently face the nation. *The Journal* believes that this is a good time for our membership to face and think about these matters. There will be much pertaining to Civilian Defense in future issues, and this article should be a useful introduction to the subject.

Then Pearl Harbor. A sneak attack that should have been expected, as such attacks have been frequent in modern warfare. Kaiser Wilhelm pulled one against Belgium in opening World War I. Hitler had Poland, Holland and Russia to his credit: why not expect one from Japan? The nation that thinks the next war will not be opened by an air attack prior to a declaration will still be a believer in Santa Claus. Pearl Harbor was a success; just how much of a success is only realized by military authorities. Had Japan by-passed the Philippines and attacked San Francisco, instead of sailing off into the South Pacific, all of the nation would have learned what a success Pearl Harbor really was. Fortunately for us, the Japanese did not appreciate their accomplishments and failed to take advantage of their opportunity. It might have been better for us, as a people, had they hit the West Coast. Then we would not now be so cocky and in a better spirit to organize for future protection.

Pearl Harbor knocked a sense of insecurity into our Pacific States. They became interested immediately in civilian defense and called for help, but there was little help to be given. During the summer of 1941 the President had established a national civilian defense organization. A demand developed for the Army to take over, but the Army could not—it had neither the personnel, trained or otherwise, nor the time to handle a project of this kind or size.

Blind pacifism had made us so parsimonious

with our armed forces that they were struggling with their own expanding organization and could not take on civilian affairs. The Army was willing to help and furnished some mature officers of high rank as advisors, along with a small group of others, mostly reserve and National Guard, to function in the states. The Army further arranged with the Chief of Chemical Warfare for the establishment of War Department Civilian Protection Schools (designated WDCPS) for the training and instruction of civilian defense personnel. These schools were operated by the Army and their faculties were largely composed of Army officers. When Pearl Harbor happened there was one of these schools running at Edgewood Arsenal, in Maryland. Its entire faculty was transported promptly to the West Coast where a lecture tour was put on, visiting the various cities in an effort to help the local civilian defense forces instruct the citizens and tighten up the loose organization that was in the making. The scare that was thrown into the West Coast at this time helped in developing what was probably the best civilian defense organization in the country, and even at that it could have been greatly improved.

A great deal of work went into civilian defense in the United States. There were, finally, six War Department schools in various sections of the country and the hundreds of students who attended them were all hard working and went home with an appreciation of what it was all about and a desire to perfect the defenses of their various states and cities. Unfortunately, the general population looked down its nose at the organization and, as time passed without it going into action, civilian defense became something of a joke. Those handling the organization, in order to keep it intact, slipped off along sociological lines and did many things remotely, if at all, connected with the war. It was these sociological and local political activities that brought civilian defense into disrepute.

Anyone intimately connected with the War Department end of civilian defense soon recognized the necessity of having a well-functioning organization. The mobs of fleeing citizens in Northern France were a contributing factor to Dunkirk and today the nations are still struggling with the problem of displaced people. The best that could be done, under the circumstances, was done in this country but it would have taken a few bombings to really whip civilian defense into shape. Our people may be great inventors, but along lines of defense they have little imagination and certainly appear unable to look into the future.

It is a lucky thing that our civilian organization was not called upon to function. City communication centers and command posts were poorly equipped, badly located, many of them were never set up, and all of them were handled as if communications would never be interrupted. It was impossible to create an appreciation of the utter disorganization that would accompany a raid. Informational and warning services were weak after they left Army control. The Japanese did drop a couple of bombs on Continental U.S.A. and even though a civilian saw the raid it was nearly a week before Army or high civilian defense authorities knew of it. When a survey was made of the incident nothing could be learned as local souvenir hunters had so combed the area there was not enough evidence left upon which to base a newspaper story or from which to even collect a museum specimen.

Unless the new Secretary of National Defense develops a department of civilian defense and puts it on a going basis the next war will be over before the Army and Navy get into the field. The protection of city populations, though not directly an Army matter, is certainly a defense problem with great military implications. It is of such importance that the nation cannot afford to put it in the hands of a hastily-thrown-together political group having no knowledge of the major problems of national security. Any future war fought will lean more heavily on industrialization than any of those that have been fought in the past and it will be more total, if possible, than World War II. Let us not forget that this nation ushered in the atomic age by wiping out two cities with a single bomb each, and unless we watch our step it will be done to us as we did to them. This is no criticism of the atomic bomb for had it been up to me to issue the order for its use the order would have been issued. It is better to be first along these lines than last.

There are nine cities in this country that, were they hit simultaneously or in quick succession, would put us completely out of business financially, industrially and militarily. Thirty planes, dropping one each of our now refined atomic bombs, would do the trick.

"Such foolishness I never heard," says Mr. or Mrs. Citizen. "Why that couldn't be." That's just the kind of thinking that made Pearl Harbor possible, that prevented the fortification of Guam. But why go on? Hawaii is a bit far from the mainland; the next lick will be several super-Pearl Harbors closer in. The world has learned that Continental U.S.A. must be the next great war target.

We gasp with horror at a hotel fire that kills 120, or a restaurant blast that takes its hundreds; we are mildly interested at a Mississippi flood; are shocked when a waterfront suddenly takes off and burns a town of a few thousand, and have pushed completely out of our memory an earthquake that wrecked a city of hundreds of thousands several years ago. After a great tragedy, locally, efforts are made to close the stable door, but the run of the mine of Mr. and Mrs. Citizen still go about "getting theirs" unless the door pinches their fingers in closing. Our next sneak attack will vaporize the door and it will never be found. We demonstrated atomic energy at Hiroshima and Nagasaki and, with our usual braggadocio, began talking about it while the post-atomic rays were still functioning. We are quick to talk and slow to act as a nation. Would it not be better to talk less and do more now that we are surrounded with iron curtains and other kinds of national secrecy and political discontent?

The realization that civilian defense must function at the opening of a future war has come to some, but by no means to most of those who will find themselves in the middle of it. Universal military training will not solve the problem—the answer is only to be found in an appreciation of its importance by the citizen, and particularly those charged with city government. After an emergency has developed the people of America go all out in national support and give enthusiastic cooperation. The trouble is that this attitude of mind must be developed during days of peace and organization maintained in a high state of efficiency for an indefinite period of time so it can function efficiently with a minimum of warning. This will be some job in a nation of independent individuals who thrive on excitement.

This will be a job to keep the Secretary of National Defense busy. Civilian defense, which should be within his organization and which will be working with a vast number of citizens, must be kept in the closest touch with military and naval affairs. All warning arrangements necessary for the protection of the nation must originate and remain in the hands of the Navy, Army and Air Corps until warnings are locally distributed. When a new weapon is developed it is the business of the military to find a defense against it and they always have, consequently all military advancements that in any way affect the civilian population must be passed on, through proper channels, so that new methods of defense may be perfected. Much material required for civilian defense may have to come from military sources; it is certain that military information concerning supply and material will have to be used by civilian defense. The civilians must also work into any military plan for general defense. The evacuation of a city of 100,000 is no simple matter; when the numbers run from 500,000 to 1,000,000 it becomes a major problem of vital interest to the military, as under war conditions the Army has priority on all channels of communication and transportation. When facing atomic bombs evacuation plans are a foregone conclusion and any such plans must have military approval.

The overall organization and training of civilian defense seems also to be a function of the Secretary of National Defense. Much jurisdictional friction would be avoided by placing these defense problems under national defense rather than having these functions under different secretaries or in separate autonomous departments as they were during World War II, when much good time was lost in efforts to harmonize ideas of people who wanted the same end but fought over which road to travel.

Naturally the burden of training, financing and maintaining the civilian organization locally will fall on the mayor and city fathers. Their departments dealing with police, fire, engineering, health and general maintenance will be the nuclei around which the citizens can be organized. The city employes are on the payroll and can be charged with organization, teaching and training. There should be no separate commander for civilian defense as this should be the function of the mayor or a city employee appointed by him or the council. Wardens, fire fighters, nurses and all such will be volunteers and may be found in civic organizations. All of these organizations, like local Red Cross, Scouts, luncheon clubs, etc., should devote a certain amount of time to the problems of defense, evacuation and caring for misplaced persons during a period of emergency. There might be times, such as fires, hurricanes and tornadoes, when city defense organizations could get practice and training. There were many instances during World War II when civilian defense functioned admirably in local emergencies such as explosions, fires and wrecks.

It is easy to understand why the Army and Navy cannot handle civilian problems during an emergency, but during peace they should be a contributing factor in organization and training. At each Army area headquarters a section on civilian defense should be established and manned by Army personnel. Army area schools, staffed

by specialized Army officers, should be available for city defense forces and student expenses should be borne by the cities. Some of these schools already exist, the Navy teaches fire fighting, the Army teaches protection from gas and incendiaries, and both have information on supply, communications and transportation that could be readily assembled in a simplified form for civilian use. Special schools need not be permanent but could be run at seasons and times as needed. They should be available in each Army area.

There is likewise a reservoir of Army and Navy personnel available to act as advisors to all city and country organizations without expense. The group is composed of Regular and civilian component retired officers, Reserve and National Guard officers on the inactive list, members of staffs of National Guard and Reserve inactive units, military personnel attached to high schools and colleges—many of these last are members of local civic clubs. The knowledge of organization, supply and communications that these men possess would be of inestimable value to civilian defense. Their services would be gladly given for no group has a greater realization of the necessity and meaning of civilian protection.

Each civilian defense organization of city or county has the problem of planning future industrial development in the communities, realizing that dispersion is the order of the day and that concentration is a mistake; command headquarters must be located on the outskirts and not in civic centers. There must be an evacuation plan and a study of all available housing, food and supplies that may help in the evacuation of a neighboring community. Hospital facilities and ways and means of rapidly expanding these must be well understood. Your city may be small with nothing of military value in it or near it, but when the metropolitan centers are hit and must be evacuated to avoid the after effects of atomic energy even though your accommodations are meager they are going to be priceless. As a matter of fact, the civilians of this nation are forced into the making of a war plan and keeping it up to date. They cannot do this satisfactorily without the assistance of Army and Navy, nor can they expect the Army and Navy to do the job for them, yet the job must be done and largely done on a voluntary basis. If it is not done or poorly done, the security and defense plans of the nation as a whole will be valueless. Organizations grow and expand rapidly under the stimulus of war; they grow, but slowly, during peace. We had better resurrect civilian defense and pray for enough peace to build it into a going concern.

For the problems of today— take counsel from the past!

During the dark and dangerous war years, the Chemical Warfare Service filled a vital section of the line defending America's freedom. Its accomplishments stand out in our nation's war record and give hope and confidence as we move forward into new areas in science and new experiences in international relations.

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Chlorine in World War II

By ROBERT T. BALDWIN
Secretary Chlorine Institute

Any history of chlorine in World War II is incomplete at this time. We are still too close to World War II to see it objectively; the armed services have not disclosed the record of some chlorine products: the chlorine producers make chlorine and related products and do not write essays on their labors. It will therefore be readily seen that this paper has very definite limits.

As the Armed Forces *Chemical Journal* has readers not familiar with the making of chemicals and as chlorine provides some interesting and unusual economics, a brief statement as to how chlorine is made seems necessary. There are, and were at the time of World War II, four chlorine processes, three of which processes are electrolytic and much alike except as to by-products. Nearly all the chlorine made is produced by the electrolytic decomposition of water solutions of common salt, sodium chloride. The electrolysis is accomplished in what is called a cell by a direct electric current of low voltage and high amperage. The cell is an imperfect instrument and the losses of energy are considerable. It follows that cheap electrical current is necessary in peacetime, and that expensive current in wartime is relative and not vital. The salt is decomposed in the cell and there are simultaneously three products evolved, chlorine as a gas, caustic soda in a water solution, and hydrogen as a gas. By suitable means, each product is kept separate from the others. The chlorine as it comes from the cell may be conducted to a nearby operation, or it may be cleansed of impurities and water and used in a nearby operation, or after purification it may be liquefied by compression and refrigeration and thereafter shipped in containers ranging in capacity from one pound to one hundred and fifty tons. Most liquid chlorine is shipped in tank cars holding sixteen, thirty, or fifty-five tons.

If, instead of water solutions, the electrolytisis of molten sodium chloride is pursued, the products are chlorine and sodium. As sodium has few uses, the amount of chlorine produced in this manner is relatively small.

If, instead of water solutions of sodium chloride, water solutions of potassium chloride are subjected to electrolysis, the products are chlorine, caustic potash, and hydrogen. As caustic potash has few uses, the amount of chlorine produced in this manner is small.

The fourth process is non-electrolytic, and small quantities of chlorine are produced incident to the synthetic production of nitrate of soda.

It is also possible to produce chlorine by the decomposition, with air or oxygen, of by-product hydrochloric acid and by other and as yet unproven means, but to date such processes are not in commercial use. The amount of by-product hydrochloric acid is relatively small and the other means appear to be uneconomic. In any event, wars do not always wait on a new process or processes, and the processes in being and providing great quantities of chlorine daily were relied upon in World War II. An electrolytic chlorine plant is normally operated seven days in each week, fifty-two weeks in each year. If the chlorine is presently in excess of the demand, the cells, arranged in series, can be cut out in series. Therefore, the production is not a batch process and there is control with a minimum of trouble.

Aside from the gaseous chlorine made and consumed on the spot, quantities of liquid chlorine are shipped to large chlorine consumers. At first thought it could be said that large consumers would make their chlorine supply. However, if they did make it, but could not consume or readily sell the caustic soda, about 10 percent by weight in excess of the chlorine weight, they are at a costly disadvantage. The sale or the use of the hydrogen, about 9,500 cubic feet for each ton of chlorine, is not so important, but in a well-balanced chemical company it is not wasted. Again, a large consumer may have neither cheap power nor cheap salt. A number of pulp mills have had small chlorine plants for 35 years, but they have a balanced chemical economy except as to hydrogen.

Chlorine is a dangerous substance and its packages and transportation are rigorously controlled by the Interstate Commerce Commission and the Coast Guard. Some idea of its dangerous nature may be had by noting a few of its physical properties. The gas is heavier than air; the liquid is heavier than water; it boils at —30.1° F.; the volume of liquid chlorine increases rapidly as its temperature increases, e.g., any container of any size loaded to 125 percent of its water capacity (the legal loading providing in effect about 18 percent gas space), is completely filled with liquid at 153.4° F.; one volume of liquid

chlorine is equivalent to 456.8 volumes of gaseous chlorine at 32° F. and 1 atmosphere pressure.

The two prime economic necessities for an electrolytic chlorine plant are quantities of cheap electric current, and common salt at the plant location or nearby. The industry is almost always located near power or makes it, and generally alongside or close to salt. This accounts for the relatively wide spread of plant locations and yet, at the same time, there are clumps of plants, such as at Niagara Falls for power and the plants at Wyandotte, Mich.; Barberton and Painesville, Ohio, and Natrium, W. Va., for salt on one huge bed of salt. These locations seem to fit to some extent the military formula as to enemy bombing, but in any event the plants are where they are for the given reasons. In wartime they cannot be moved or duplicated elsewhere except at a huge cost in money and time. Money is plentiful in wartime, but time is wanting.

In World War I, from the chlorine point of view, the emphasis was on the so-called war gases. In World War II, war gases were made and stored in quantity, but the emphasis was on many new wartime uses or expanded old uses which absorbed great quantities of chlorine either as a tool of manufacture or as a component of the finished product. World War I was a small war measured by World War II. During World War II, tetraethyl lead, degaussing cables, ethylene glycol, and other goods consumed trainloads of chlorine weekly. At the same time the domestic economy requiring chlorine expected the industry to provide chlorine and, while cuts had to be made, there was no grave dislocation.

Several government functions prior to the war, including the armed forces, had at intervals collected information about capacity and products of industry generally. The Chemical Warfare Service for some years prior to World War II had a very few officers whose duties included surveys of chemical plants and their products and statistics. By a military order effective July 1, 1939, President Roosevelt as Commander-in-Chief of the Army and Navy began the direction and supervision of the Joint Army and Navy Munitions Board and several other boards. Early in 1940 the Joint Army and Navy Munitions Board, concerned with harmonizing the plans of the Army and Navy for the procurement of munitions and supplies for war purposes, also made inquiries concerning chemical production and to implement its work provided a Chemical Advisory Committee. This committee in turn provided itself with sixteen subcommittees, one of which was named the Alkali and Chlorine Committee. The Alkali and Chlorine Committee was organized and held its first meeting on June 19, 1940, with Mr. A. B. Chadwick of Solvay Process Co. as chairman. Col. H. A. Kuhn, then a captain in Chemical Warfare Service, attended this meeting at the request of the committee. Subsequently Col. Kuhn was appointed contact officer by and for the Board on this committee. On several occasions, Mr. S. W. Jacobs, President of the Chlorine Institute, Inc., served as acting chairman. On May 11, 1942, the Navy appointed Ensign W. W. Crawford as contact officer for the Navy to this committee. As of September 14, 1943, Lt. Comdr. R. B. Colgate replaced Ensign Crawford. This committee held many meetings; it provided its minutes, and also statistics collected by and consolidated by the Chemical Warfare Service to the Army and Navy Munitions Board; it also provided tank car records and other matters derived from freight tariffs and the regulations of the Interstate Commerce Commission.

The chlorine capacity of the industry was one of the earliest problems of the Chemical Warfare Service. It seemed likely that large government requirements in the event of war could not be met and at the same time take care of the domestic economy unless resort was had to either some form of allocation or new capacity built. This condition led to provision for statistical reports and ultimately, when war came, to a building program. On March 19, 1941, Office of Production Management, after conferences with Army and Navy Munitions Board and Priorities Division of the first named, issued Division Administrative Priorities Order No. 1, which put chlorine on a "priorities critical list." This list was amended at intervals but chlorine stayed "critical" throughout the war. On June 12, 1941, the Office of Production Management issued an order to the pulp and paper industry to reduce average daily consumption to not more than 90 percent of daily average consumption for the month of May, 1941. This cut and an increased cut continued for several years and is indicative of the chlorine situation. In July, 1941, the U. S. Department of Commerce reported that an "arsenal" would be built at Huntsville, Ala., and while there appears to be no public record at the time Edgewood Arsenal was apparently building a chlorine plant early in 1942. Subsequently two additional arsenals were built, one at Pine Bluff, Ark., and one at Denver, Colo. These four arsenals had a total daily capacity of 300 tons of chlorine and all operated successfully.

The Chemical Warfare Service was also concerned about suitable supplies of bleaching powder, a mixture of chlorine and slaked lime, neces-

sary for mopping up gases in the event of bombing. As bleaching powder had been largely replaced with liquid chlorine and modern dry powder hypochlorites in the period after World War I, there was not sufficient bleaching powder plant capacity. One new plant with the capital cost supplied by the government was built, but upon completion a fire destroyed it. Fortunately there was no gas bombing.

Effective July 26, 1941, and unless sooner terminated expiring on December 31, 1941, the Office of Production Management (later succeeded by the War Production Board) provided "General Preference Order No. M-19, To Conserve The Supply And Direct The Distribution Of Chlorine." It will be noted that this order preceded the declarations of war by five months, as war was declared on Japan on December 8, 1941, and on Germany and Italy on December 11, 1941. This order, first amended on December 20, 1941, and provided with a penal section, was continued throughout the war period. The order was comprehensive and either by priorities and/or allocations absolutely controlled the distribution of chlorine, both gaseous and liquid. At all times the government needs, both in its own plants and contractors' plants, came first and the vital, though small, consumption of chlorine for sanitary purposes was next. The order was further amended on February 25, 1942; March 9, 1942; March 30, 1942; May 1, 1942; May 22, 1942; December 1, 1942, and June 26, 1944.

As said elsewhere in this paper, electrical current is a prime consideration in chlorine production. Before war was declared, a power shortage could be predicted and, for example, the Federal Power Commission, by temporary authority, on June 12, 1941, provided additional diversion of water from the Niagara River at Niagara Falls. On September 24, 1941, this diversion of water was covered by further authority and in the meanwhile the additional electrical power had been allotted by the Federal Power Commission.

There was a very definite shortage of chlorine in 1941 as indicated by the action of the Office of Production Management. Among the efforts made that yielded chlorine there were several worthy of special note. The Ethyl Corp., in November, 1941, arranged to build a plant for the production of hydrochloric acid in order to substitute the acid for the chlorine it produced and consumed incident to the manufacture of sodium; the merchant producers of chlorine, to the extent that power was available, increased the amperage of the cells, thus providing more chlorine from the same apparatus, although this practice shortened the life of two parts of the cells. However, these parts were obtainable. The chlorine plants on the Pacific Coast, because of the cuts in chlorine consumption at pulp and paper mills, were able to ship chlorine across the continent to the government and to government contractors. This long haul, of course, increased the total time a car was in transit both ways and added to the already visible shortage of tank cars. However, the long hauls helped relieve the chlorine situation in the East and caused great effort to cut down the turnaround of the whole chlorine tank car fleet.

In November, 1941, the Office of Production Management considered a tentative program of its own making for 2,000 tons new chlorine capacity and 700 tank cars, both items to be financed by the government.

On January 14, 1942, the Office of Production Management, under Executive Orders Nos. 8629 and 8875, issued Regulation No. 12, which regulation made possible industrial advisory committees. On November 9, 1942, a number of representatives of the alkali and chlorine companies were constituted an advisory committee and met on call in Washington throughout the war period. To implement the functions of the Army and Navy Munitions Board and the War Production Board, contact officers were later provided by these functions and the contact officers were very helpful.

By the spring of 1942 the government had its chlorine plant expansion under way, and a good-sized fleet of tank cars, including the first tank cars of a new size, 55 tons capacity, were building. The industry, to the extent of available power and the ability to obtain more cells and repairs to old ones, was also expanding. The estimated entire production for the prewar and war period is as follows:

Year	Gas, including liquid Tons (2000 lbs.)	Year	Gas, including liquid Tons (2000 lbs.)	Year	Gas, including liquid Tons (2000 lbs.)
1923	153,300	1932	240,800	1940	696,472
1924	149,100	1933	279,300	1941	811,904
1925	180,180	1934	341,090	1942	1,065,775
1926	193,690	1935	363,200	1943	1,266,261
1927	202,700	1936	419,700	1944	1,343,950
1928	217,160	1937	506,900	1945	1,192,081
1929	271,600	1938	571,200	1946	1,165,161
1930	241,420	1939	579,800	1947	1,500,000
1931	250,190				

On May 4, 1942, the Office of Defense Transportation, under the authority of Executive Order No. 8989, issued "General Order O.D.T. No. 7," owing to an increasing shortage of tank cars of all kinds and the need for conservation. This order provided a permit system and, as amended at intervals, continued in some effect throughout the war period. As practically all

tank cars are owned by other than rail carriers, this order was of considerable interest. However, as the rail carriers do not hold themselves out to provide such equipment and in lieu thereof do provide a mileage allowance in certain tariffs for all pressure tank cars, the regulations and permit system was speedily applied and ultimately proved helpful.

The emphasis on chlorine raises the question, "Was there no substitute for chlorine?" The other halogens, bromine, fluorine, and iodine, were not available in quantity and for many chlorine uses were and are impossible of substitution. Moreover, the manufacture of chlorine helped to provide the great quantities of caustic soda needed.

As caustic soda is also produced by treating soda ash with lime, it follows that the expansion of the chlorine industry had the effect of increasing the soda ash supply. Had a large production of bromine, fluorine, and iodine been possible, and had the substitute uses been possible, there would not have been a pound of caustic soda produced thereby.

No complete list of chlorine uses is possible, as much of the information about military uses was and still is restricted and uses of indirect military importance were either practiced as an art or are now covered by patent applications. Among the hundreds of uses during the war were—

Aviation gasoline
Bleaching powder
Bromine, extraction from sea water of
Carbon tetrachloride
Dichlordifluoromethane
DDT (dichlorodiphenyltrichloroethane)
Ethylene glycol
Hexachlorethane
Hypochlorites
Metallurgical processes
Methyl chloride
Phenol
Plastics
Pulp, bleaching of
Sanitation
Synthetic rubber
Tetraethyl lead
Textiles, bleaching
Trichlorethylene
War gases and smokes

The industry worked its plants to the limit; added capacity where possible; made repairs to the extent that any material was available and in spots resorted to patches on patches. There was a grave shortage of valves, pipes, and pipe fittings. The expansion of the industry and the operation of the Chemical Warfare Service Arsenals and the draft dislocated the number of skilled professional and technical employees. There were strikes at industry plants. Bad winter weather and a scarcity of tank cars on several occasions made an already bad situation worse. On the other hand, there were ample supplies of electrodes, largely due to the foresight of National Carbon Co., Inc. The Hooker Electrochemical Co. not only produced as needed a very substantial proportion of all the new chlorine cells, but trained men to operate the cell plants.

It still remains that a chlorine industry is an important and constant element of military preparedness at no expense to the taxpayer. Moreover, chlorine has the unique position of being an indispensable element in the sanitation of water intended to be made potable and in the treatment, to some extent, of sewage. Chlorine has had an interesting history since its discovery by Scheele in 1774. Its modern uses are, in numerous cases, part of the remarkable growth of the whole chemical industry. Chlorine uses are surely not exhausted. The industry will grow in all probability as the peculiar properties of chlorine are better understood and put to still more uses.

Throughout the entire life of the Chemical Corps and its predecessors, this valuable arm of the military forces has kept itself aware of the chlorine industry and maintained harmonious relations with it. These relations continue and are indispensable in any program of national defense.

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The Development of the 4.2 Chemical Mortar

PART I—EARLY HISTORY AND DEVELOPMENT

By GEORGE A. MILLER*
Technical Command, Army Chemical Center

Foreword

The story of the development of the Chemical Corps' 4.2-in. chemical mortar is a record of remarkable achievement. It had a prelude in the original 4-in. Stokes or British mortar used with considerable success during World War I, and its usefulness during that period set a pattern to some extent for an extensive development program which was to follow.

Soon after World War I, a fast tempo was given a mortar development program upon orders from the Chief of the Chemical Warfare Service to increase the range and serviceability of the 4-in. Stokes mortar. It has often happened in the history of man's progress that new successes are obtained only when a radical departure from the old system has been made. So it happened that startling increases in range and accuracy of fire resulted when a smoothbore 4-in. Stokes barrel was rifled and a shell designed for spin-stabilizing was put to test. With new impetus, the Mechanical Division of Edgewood Arsenal attacked the problem, and first priority was given to the development of the 4.2-in. chemical mortar.

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Figure 1
4-inch Stokes Mortar and Ammunition

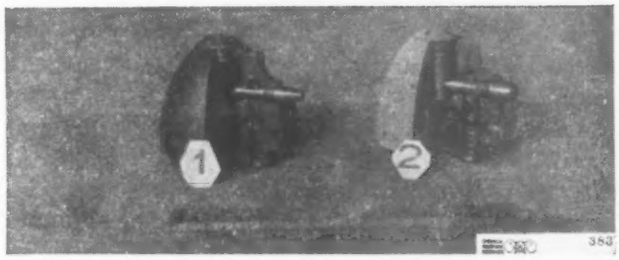

Figure 2
4-inch Stokes Mortar Shell Fuzes, Mark XI and Mark XI M1

This tempo of development, however, soon became slow and laborious as the engineers faced the many and diversified problems incident to the adoption of a spin-stabilized projectile. It was a long step from a tumbling shell made basically from a piece of pipe and fired from a smoothbore gun, to a rotating type projectile stabilized by firing from a rifled barrel. The new problems involved interior and exterior ballistics, stress distribution and mechanical adequacy, and proper ground support, all of which are important in obtaining long range, accuracy, mobility, high rate of fire and permanency of emplacement.

The development of the 4.2-in. chemical mortar was not the result of the effort of one man or a group of men. The development period covered the years 1916 to 1948. During this time men came and went, but the 4.2-in. chemical mortar stayed on, for many years a challenge to those who sought to determine the cause of a premature, a tumbling shell, a bent elevating screw, or a broken tie rod.

The development has reached its finale so far as the Chemical Corps is concerned, for on December 31, 1947, upon orders from the Chief of Staff, Department of the Army, the 4.2-in. chemical mortar M2 was made an item of procurement and issue by the Ordnance Department to all defense agencies requiring its use, due to the fact that the 4.2-in. chemical mortar was adopted by the Army Field Forces as a weapon organic to the heavy mortar company of the infantry regiment. An improved mortar for long-range work is under development. Men and officers who have had the occasion to test its performance, have a great deal of praise for it. The Chemical Corps is rightfully proud of the 4.2-in. chemical mortar, the result of years of concerted effort to attain a worthy objective.

Early History

The predecessor of the 4.2-in. chemical mortar was the 4-in. Stokes trench mortar which was used for over three years by the British and for nearly a year by our special gas troops during World War I. This mortar was used in placing toxics and thermite on the enemy's front lines and communicating trenches with a great deal of success under a great variety of conditions. A large amount of phosphorus-filled shell was used mainly for its incendiary and casualty-producing effect. The smoke-producing effect was, at that time, incidental. The Stokes mortar was originally designed by the British in July 1916 and was carried forward by them until early in 1918, when the United States Ordnance Department prepared design specifications for the contemplated manufacture of mortars in this country. In July of the same year, the necessity for procurement by the United States Government having arisen, contracts were placed and approximately 400 American mortars were completed, but were not used overseas due to the signing of the Armistice in November. The 4-in. Stokes mortar was intended primarily for placing sudden and high concentrations of agent on limited objectives at close range. Material hits were not necessary. All that was required was that the dispersion be not greater than the target area to be covered. At the close of the war, the United States Government bought from the British a large number of Stokes shells and propellant charges and much of the initial experimental work at Edgewood Arsenal was done using this material.

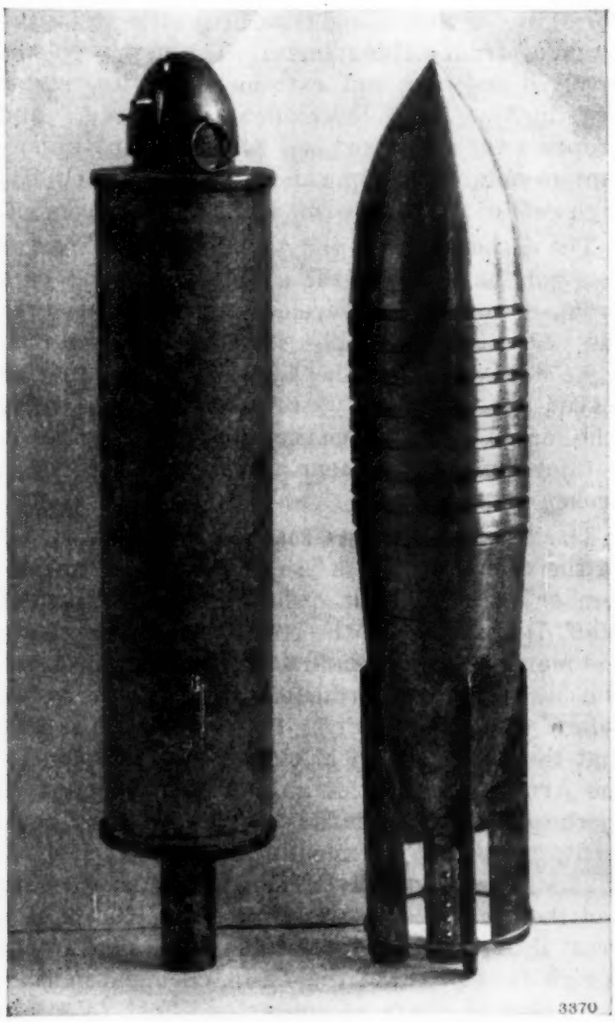

Figure 3
Experimental Streamlined Stokes Mortar Shell

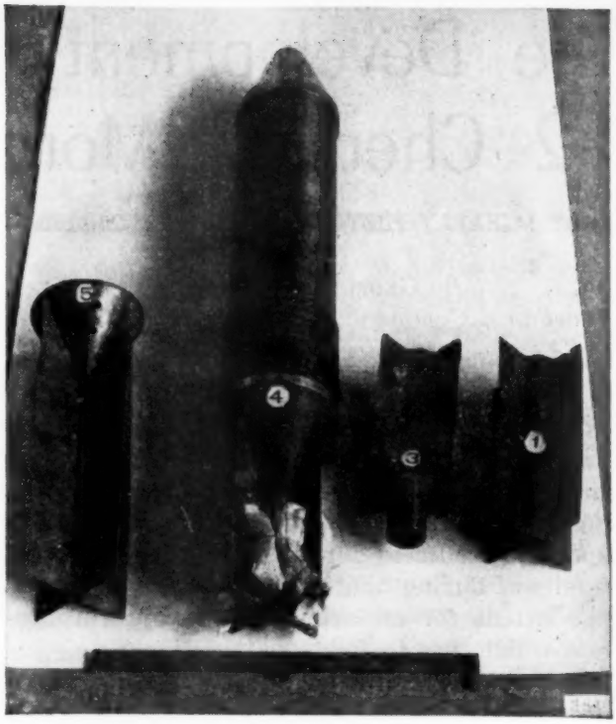

Figure 4
Experimental Stokes Mortar Shell Showing Gas Check Grooves and Stabilizers

Description of Stokes Mortar and Ammunition

Referring to Figure 1, it will be seen that the

Figure 5
Stokes Mortar Cart—Development Type

4-in. Stokes mortar consisted of three parts: a 4-in. smoothbore muzzle-loading barrel, a base support consisting of a round steel plate bolted to a hardwood subbase and a folding bipod which carries the elevating and traversing screws and supports the barrel near the muzzle. The base of this mortar is intended to be dug in to secure adequate support against the ground during firing. The bipod is readily detached from the barrel clamp and the base cap of the barrel rests loosely in a socket in the base.

The shell used with the 4-in. mortar was one of the simplest forms of ammunition. It consisted of a length of pipe or tubing, with two forged heads screwed into the ends to close the shell and serve also as guides. A burster tube, an all-ways impact fuse, and a cartridge container completed the shell.

Four types of propellant were used with the 4-in. shell. These were: the British biscuit charge with E. C. powder, the British cordite rings, the American Hivel rings, and the American flashless nonhygroscopic disk propellant. All except the last deteriorated rapidly and gave erratic results due to moisture absorption. Attempts to place the propellant in moisture-proof containers were unsatisfactory. The disk propellant gave good results except at reduced charges. The development of a new nonhygroscopic disk propellant was requested of the Ordnance Department and this became the origin of the present day disk propellant.

The 4-in. mortar shell used during World War I was fired with time and with impact fuses. Mark XI and Mark XI M1 impact fuses are shown in Figure 2. The former fuse became inoperative on storage due to corrosion of the striker pin and the permanent set in the safety fork spring. The modification of this fuse resulted in the Mark XI M1 fuse.

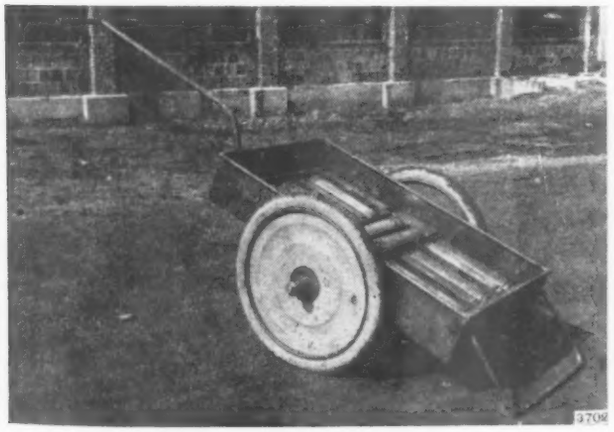

Figure 6
Stokes Mortar Cart—Development Type

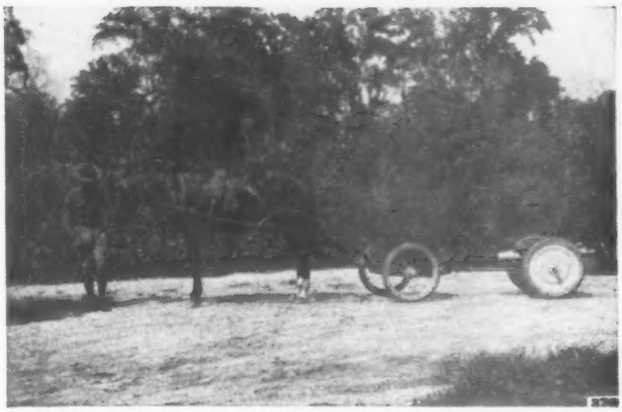

Figure 7
Stokes Mortar Cart—Development Type

Early Development

The question arose early in 1924 whether the 4-in. Stokes mortar should remain a weapon of the Chemical Warfare Service or should be transferred to some other branch. To assist in determining the status of the mortar, Lt. Col. (later Major General) Brigham ordered a full set of photographs and descriptions of all developments which had been made up to that time in connection with the 4-in. Stokes mortar, shell, carts, and accessories, for use in a conference at Ft. Benning in February 1924. The status remained unchanged as a result of this conference and a new development program was initiated, the purpose of which was to increase the range and serviceability of the 4-in. Stokes mortar.

There were several inherent defects and important limitations of this mortar which are described as follows:

1. The 4-in. Stokes mortar fired a tumbling shell, necessitating an all-ways fuse in order to detonate it in any position of impact. It was believed impossible to effect efficient liberation of the chemical agent from shell in which the position on impact could not be predicted or controlled.

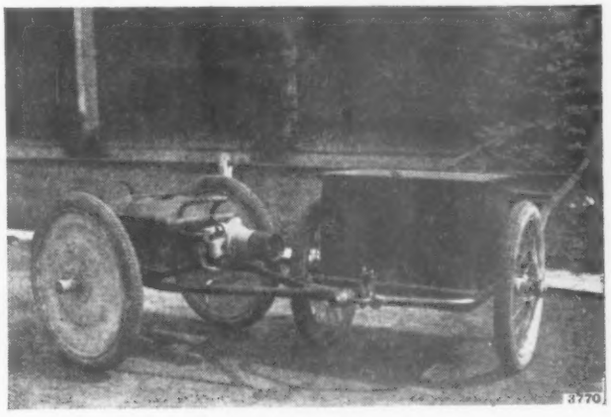

Figure 8
Stokes Mortar Cart—Development Type

Figure 9
Stokes Mortar Cart—Development Type

2. The maximum range of the tumbling shell was about 1100 yards.

3. The baseplate was mechanically inadequate, as a renewal of the oak subbase was necessary after firing about 20 rounds at maximum range.

4. Transportation of the mortar was laborious and clumsy.

The attempt to increase the range and mobility of the 4-in. Stokes mortar was generally unsuccessful and may be summarized as follows:

1. Attempts at streamlining the shell as shown in Figure 3, and stabilizing the shell by the addition of an ogive and finned members at the base of the shell, yielded erratic results and introduced serious problems due to the decrease in density of loading.

2. An attempt to increase the range by decreasing the clearance between the diameter of the shell and the inside diameter of the barrel and the addition of gas check grooves (Fig. 4) yielded some increase in range. It appeared that the limit of range obtainable with the 4-in. Stokes mortar using the maximum allowable charge of powder was approximately 1500 to 1600 yards.

3. In order to increase the mobility of the 4-in. Stokes mortar, there was constructed a specialized mode of transportation consisting of a cart for the mortar and accessories (Fig. 5) and a caisson for its ammunition (Fig. 6). The combined unit is shown in Figures 7, 8, and 9.

4. While work on the carts was being carried forward, work was progressing on the development of a mounted 4-in. mortar. A photograph of the first wooden model is shown in Figure 10. This model incorporated a 5-in. spring-hydraulic recoil mechanism on the side of the barrel. One sample of the barrel and recoil device was constructed and fired for the purpose of obtaining hydraulic pressures but the design showed many defects and was abandoned. Another interesting design of a 4-in. mortar was submitted by Frank B. Hale of the Mechanical Division in January 1924. It consisted of a spring-hydraulic recoil mechanism mounted on the side of a cradle which supported the barrel. A 12-in. recoil of the barrel was permitted; the recoil energy being absorbed in forcing the oil through small bypass orifices. The coil spring was used to return the barrel to the original position. This design also had a tripod support for the front end of the cradle and also carried the elevating and traversing screws. When the standard was placed in position as in firing, the wheels were lifted off the ground and moved with the cradle during setback. No sample of this design was ever constructed as a new development program was in process of formation.

The new development was to center about the requirements for a mortar having a range from 700 to 2500 yards, be no heavier than the 4-in. Stokes mortar, be easily transported and handled,

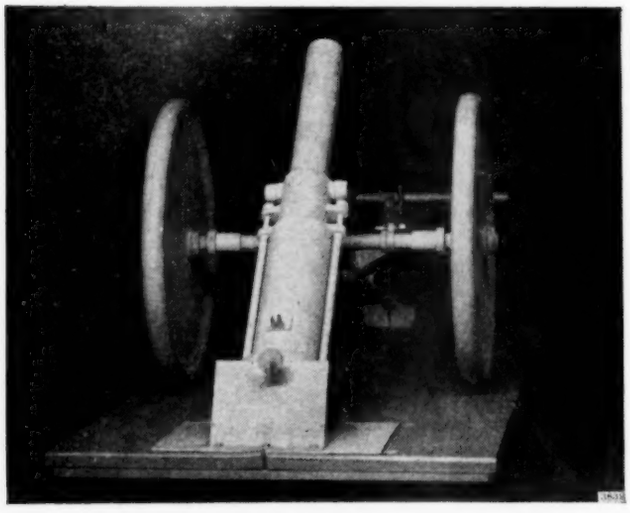

Figure 10
Model of Mounted 4-inch Mortar

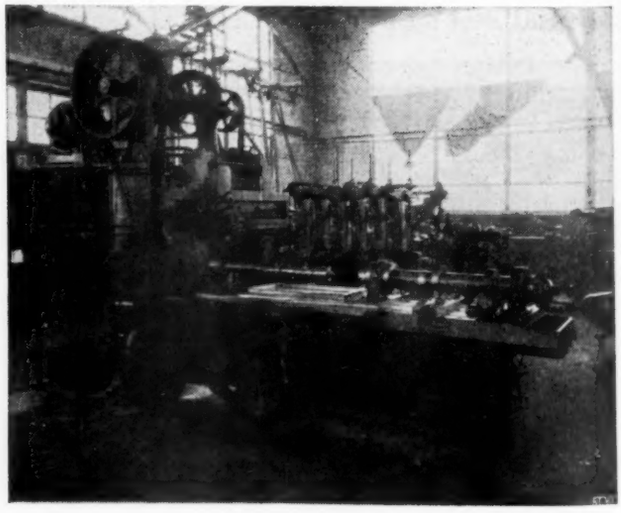

Figure 11
Machine for Rifling Stokes Mortar Barrels

and to have approximately the same rate and weight of fire as the Stokes mortar.

Barrel Development

Having failed in their efforts to increase the range of the 4-in. Stokes mortar to the desired extent, it soon became evident that the problem must be attacked along different lines. It was decided that a rifled barrel offered best promise of attaining the desired results. A rifled barrel and shell having a gas check had been designed by the Mechanical Division under the direction of Capt. (later Col.) L. M. McBride as early as December 1920. In March 1924 the Chief of the Chemical Warfare Service ordered a Stokes mortar barrel rifled and tested.

The immediate problems connected with this order involved such considerations as: the diameter of the bore, the pitch and form of rifling, form and number of grooves, length of barrel, length of firing pin in the barrel, and a shell and fuse designed for the rotation imparted to it in being fired from a rifled barrel.

Drawings were prepared of a series of experimental barrels to be machined from the Stokes mortar barrels on hand. In truing the inside diameter of these barrels preparatory to rifling, the bore became 4.2-in. diameter. The various forms of rifling to be tried were cut on a planer in the machine shop at Edgewood Arsenal (Fig. 11).

Ten Stokes mortar barrels were rifled, the first three (E1, E2, and E3) with increasing pitch of rifling according to the curve form of a semi-cubic parabola, from 0 to one turn in 20 calibers at the muzzle. Barrel E1 had 8 grooves, E2 had 16, and E3 had 24 grooves or machined surfaces between lands. Barrel E4, with 24 grooves, had a pitch first increasing according to a semi-cubic parabola from 0 to one turn in 15 calibers at a point 8 inches from the muzzle, then constant pitch at one turn in 15 calibers. Barrel E5 had 24 grooves with pitch increasing according to a semi-cubic parabola from 0 to one turn in 15 calibers at the muzzle. Barrel E6 had 24 grooves with constant pitch of one turn in 15 calibers. Barrel E7 had 24 grooves with uniformly increasing pitch from 0 to one turn in 15 calibers at the muzzle. Barrel E8, E9, and E10 had 24 grooves

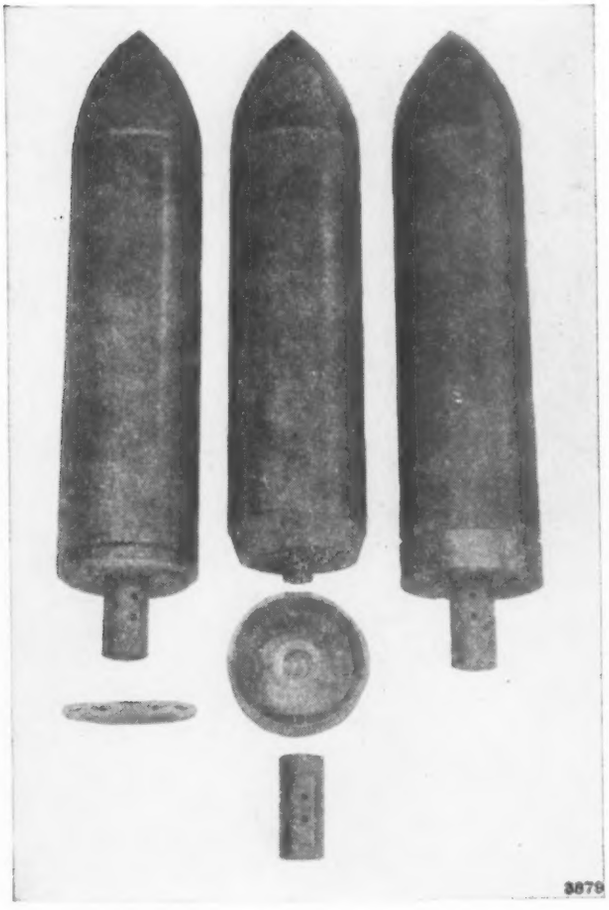

Figure 12
Early Experimental Types of 4.2-inch Shell

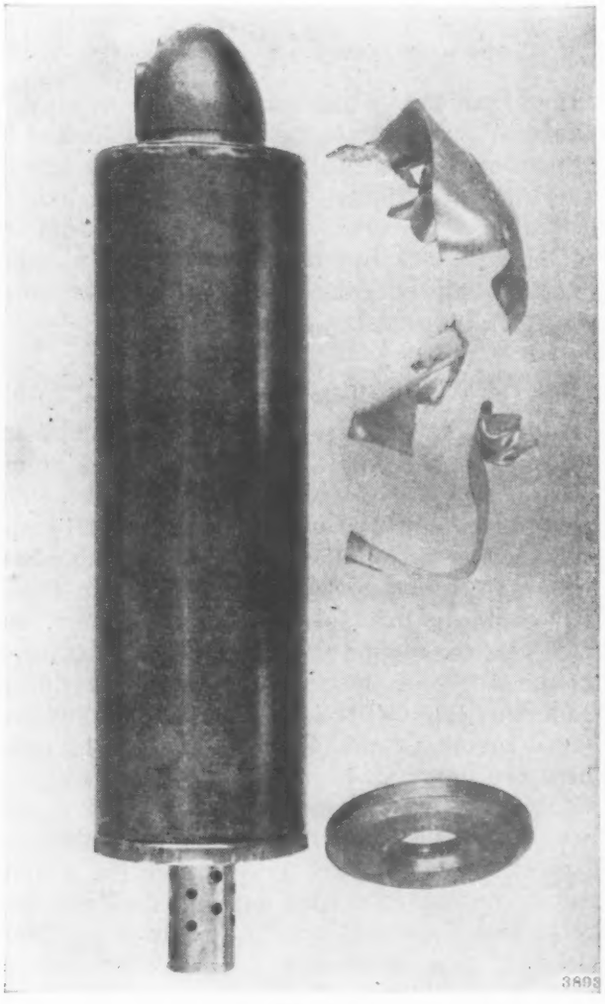

Figure 13
Experimental Type of 4.2-inch Shell

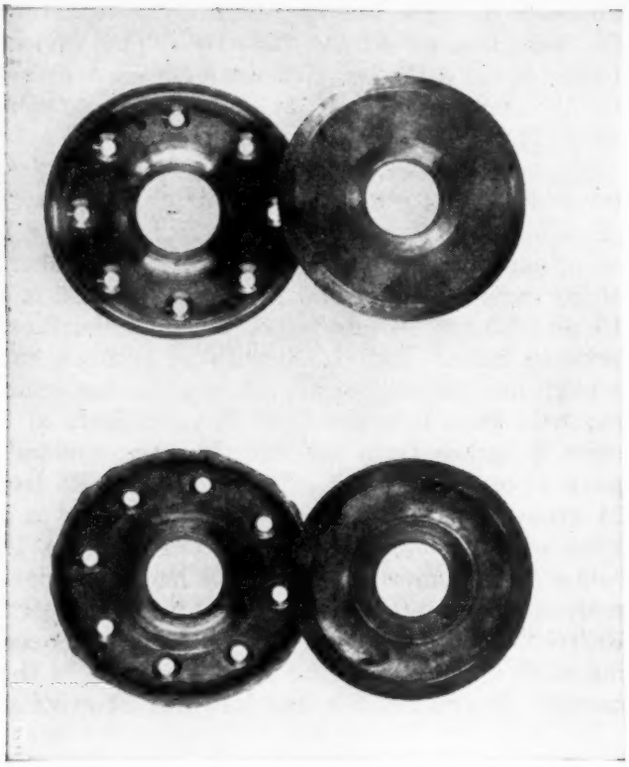

Figure 14
Experimental Pressure Plates and Rotating Disks

with increasing pitch according to semi-cubic parabola from 0 to one turn in 25, 31, 25, and 30 calibers at the muzzles, respectively. All barrels except E6 had riflings parallel with the axis of the bore at the origin. This was done so that the "take" or engraving of the expanded member would be independent of rotational effects which might inhibit proper action.

Shell Development

In order to test these barrels, it was necessary to design a shell which would engage the rifling of the barrel and receive rotation in flight. The principle of single-wedge action (Shell E1) and double-wedge action (Shell E2) on a double-base shell was first considered. A third design (Shell E3) used the principle of double saucers, the inner part collapsing under pressure and expanding the flange of the outer part into the rifling. A fourth design (Shell E4) employed a wedge-shaped cup on a tapered section of the shell base. These are shown in Figure 12.

Firing tests of Shells E3 and E4 were conducted using Barrel E1. Only a slight indication of rotation was observed in part of the rounds fired. The wedge-shaped cup of Shell E4 was slotted and tested. It was also made of lead, but neither of these methods yielded positive results.

Due to the failure of all methods tried so far to impart rotation to the shell, a new development of the double saucer idea was made, and is shown in Figures 13 and 14. In this design, a stud on the base of the shell held the steel cartridge container which in turn held the steel pressure plate and brass rotating disk in place. As in the shell E3, the pressure plate was designed to collapse under pressure and expand the flange of the brass rotating disk into the rifling. The rotating disk was fastened to the base of the shell by screws. Three inert rounds fired with barrel E2, having 16 grooves, gave the first true flight obtained with the 4.2-in. chemical mortar. The range was 2270 yards at 45-degree elevation of the barrel and all three rounds impacted in a 10-yard circle. Barrel E1, having 8 grooves, was abandoned as it was the consensus that this type of rifling had too much land area to permit proper engraving of the brass rotating disk.

Further testing of the steel pressure plate showed that if its thickness were too great, it functioned by wedge action only and did not result in sufficient "take" to produce the proper amount of rotation of the shell. If the plate were too thin, it would collapse and fail to expand the

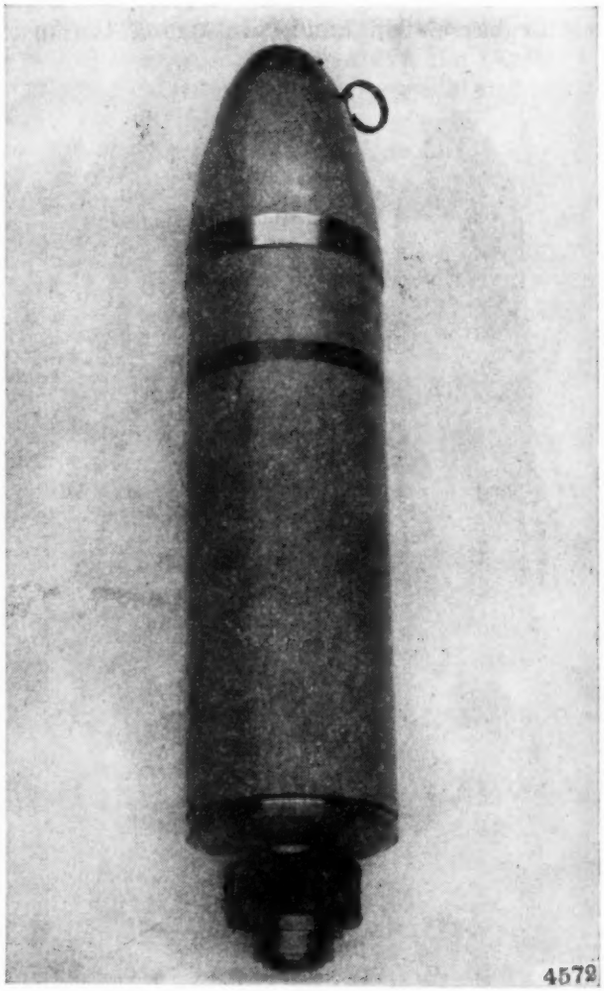

Figure 15
Experimental 4.2-inch Shell

rotating disk sufficiently to induce rotation. It was found that best results were obtained by undercutting both the pressure plate and rotating disk at the diameters where they were intended to be deformed by pressure. A method of binding the brass rotating disk to the base of the shell by knurling both parts instead of by the use of screws was successful for the powder charges then in use, but was proven to be inadequate for higher acceleration rates. Several lengths of shell casing and ogival heads were tested until the design shown in Figures 15 and 16 was found to give best results as to stability and filling efficiency.

This shell represents a radical departure from the old Stokes mortar shell which was not strong enough to withstand the setback forces incident to the higher muzzle velocities required for the increased ranges desired. The new shell was turned from a heat-treated steel forging to obtain increased strength. The ogive was welded to the shell casing and carried an internal welded adapter, through which the shell was filled from the nose. After filling, the long burster well was inserted in the hole in the adapter and press-fitted to seal the opening. This method of filling and sealing to prevent leaks was instituted by Capt.

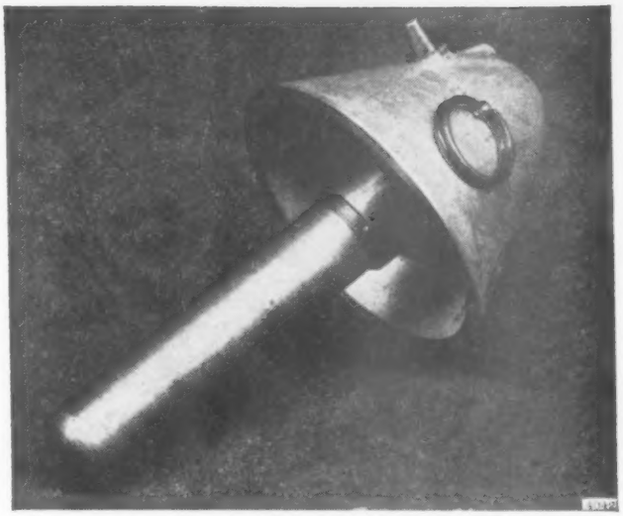

Figure 17
4.2-inch Shell Fuze with Short Burster

Figure 16
Sectional View of Experimental 4.2-inch Shell

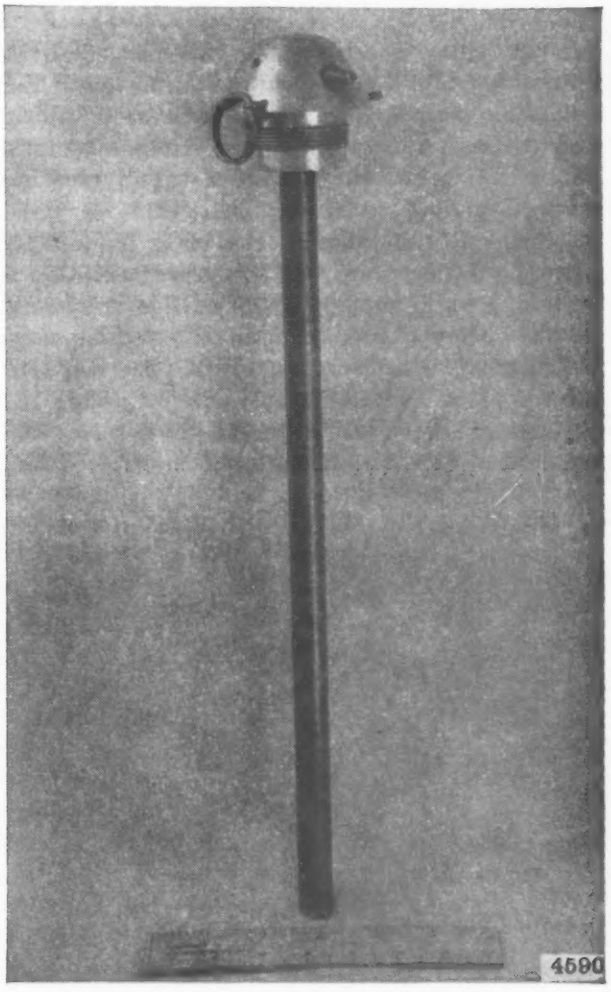

Figure 18
4.2-inch Fuze with Long Burster

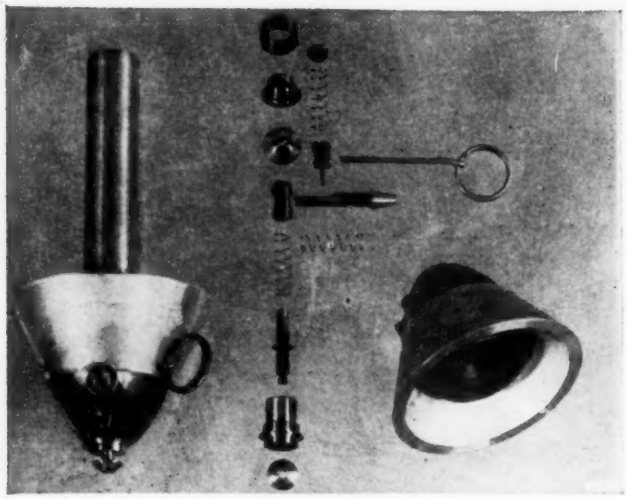

Figure 19
4.2-inch Fuze Components

L. M. McBride in December 1926 and is the method used today on all chemical shell.

The original burster extended only a short distance below the head of the shell and yielded incomplete bursts. The burster tube was later changed to extend nearly to the bottom of the shell and complete bursts were obtained.

A particular difficulty was experienced in the behavior of liquid-filled shell. It was found that shell which gave true flight with solid fillings tumbled when filled with liquids. In an attempt to overcome this, the shell interior was divided into compartments by means of partitions or vanes running longitudinally in the shell body. The purpose of the vanes was to impart rotation to the liquid while the shell was still in the barrel. Having obtained good results with a four-vaned construction, a three-compartment vane was tried and found to function satisfactorily (Fig. 16). Good results were also obtained with a two-compartment vane. In all cases the vanes were fastened to the shell casing by screwing or welding. It was discovered by trial that if a two-compartment shell is dropped into the barrel with the plane of the vane in a horizontal position, the yaw of the shell in flight is greater than if it were dropped with a vane in a vertical position. This was due to the retarded equalization of the liquid across the diameter of the shell in the former case since, to equalize, liquid must flow through pierced holes in the vanes, whereas, in the second case, the flow is unobstructed.

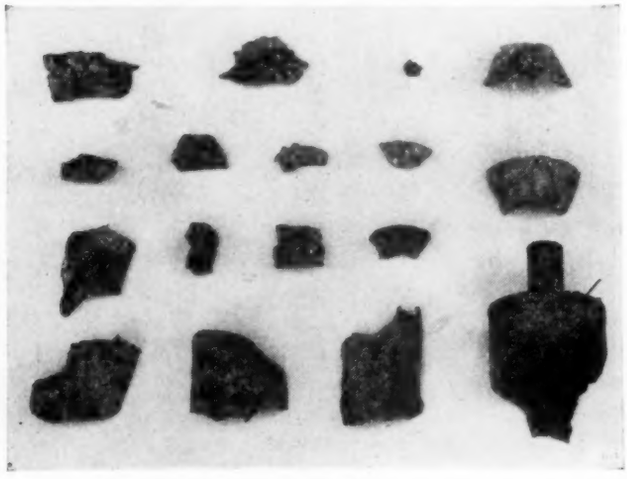

Figure 20
Fragmentation of 4.2-inch Shell—Surface Burst

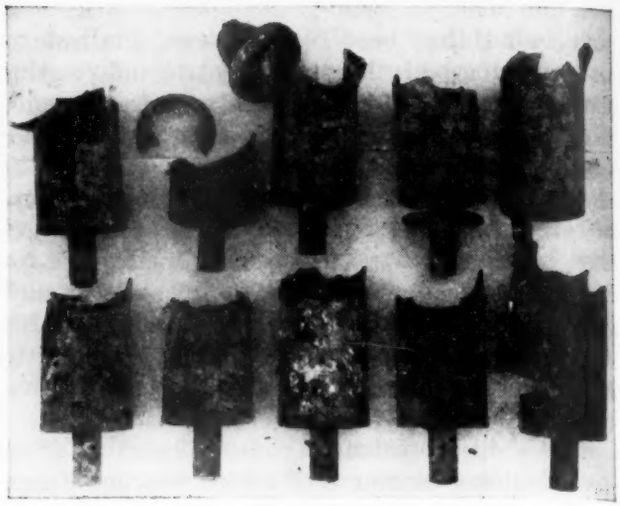

Figure 21
Fragmentation of 4.2-inch Shell—Underground Burst

Fuse Development

With the development of a stable flight shell, the necessity for a point-detonating fuse arose.

The Mark XI "all-ways" fuse used with the Stokes mortar shell immediately became obsolete for a rotating type shell since prematures would surely occur as a result of functioning of the "all-ways" element acted upon by centrifugal force.

The first fuse tests were made using Mark XI

Figure 22
First All-Metal Baseplate—Bottom View

Figure 23
First All-Metal Baseplate—Top View

fuses modified to void the "all-ways" feature. These functioned but due to the slow-burning black powder used in the fuse, the shell burst was very much delayed and the smoke filling was mostly trapped underground. A review of the Ordnance Department fuses was made to determine a possible application of these to chemical mortar shell. Only one appeared to offer promise, the Mark III point-detonating fuse. It was found that this type fuse would not always arm due to the relatively low rotative speeds of the chemical mortar shell.

Further attempts were then made to modify the Mark XI fuse by replacing the black powder with fulminate of mercury and increasing the length of the burster from that as shown in Fig. 17 on photo 4042 to that shown in Fig. 18. Fig. 19 shows the order of assembly of the fuse parts, and Figs. 20 and 21 show the comparison of results of point detonation at the surface of the ground with bursts underground which resulted when using black powder.

Some difficulty was experienced with breakage of the cast iron bodies of the original Mark XI fuses resulting from the setback forces. To overcome this, an aluminum alloy body was then made as shown in Figure 18. An interesting model of a mechanically delayed-arming fuse was designed and fabricated in 1925. This fuse was a supersensitive point-detonating bore-safe type, having also the additional advantage of functioning on base impact, a feature desirable in that stage of mortar development when short ranges were secured by firing at high angles of elevation with consequent base impact of shell.

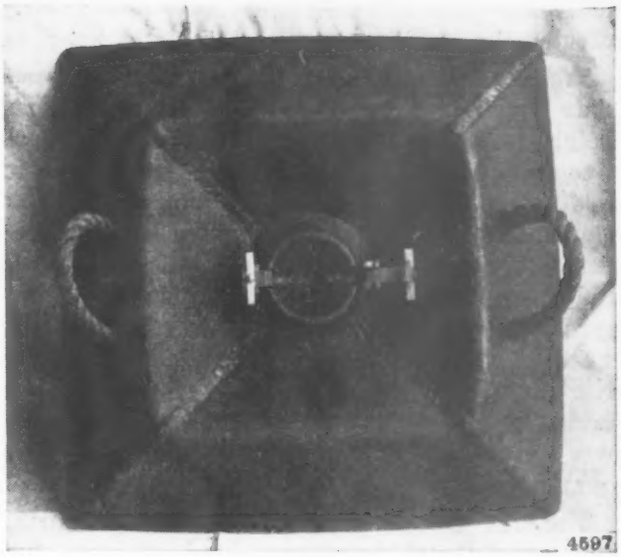

Figure 25
Improved Baseplate

This fuse showed exceptionally good performance; however, it was quite complicated and was finally abandoned in favor of the comparatively simple Mark XI modified.

Baseplate Development

Before taking up the results of tests of the various rifled barrels described above, it seems advisable to review briefly the early development

Figure 24
Experimental Baseplate

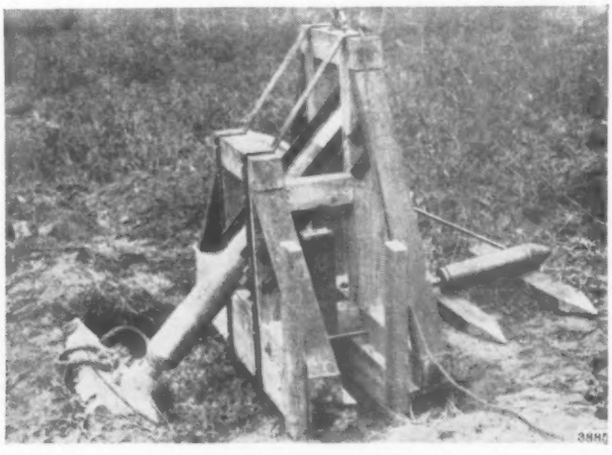

Figure 26
Experimental Firing Set-up—Side View

of the baseplate and the standard as these greatly affected the stability of the assembly as a whole.

Figures 22 and 23 show the first all-metal baseplate which, however, failed in firing. This plate weighed 78 pounds. Metal brackets with lock pins were riveted to the plate for the purpose of holding the gun in position. A similar plate was constructed with reinforced center which failed also, whereupon, an entirely new design was made and a sample fabricated (Fig. 24). This plate was pyramidal and had a tendency to overturn, necessitating frequent resetting of the mortar. The overturning tendency was overcome by a plate having a depressed center and hooks which slip over the base-cap studs to prevent the barrel from jumping out of the socket (Fig. 25).

The first "setup" of the 4.2-in. chemical mortar for experimental firing, consisted of a wooden frame with steel slides for supporting the barrel at the desired elevation. This is shown in Figures 26 and 27. The steel slides prevented rotation of the barrel and at the same time, permitted the barrel to recoil against the breastplate.

Realizing that force to resist rotation of the barrel was too great to be carried on the bipod of the Stokes mortar, it was decided to assemble the barrel to the bipod by means of a collar, leaving the barrel to turn independently of the bipod. The barrel was then prevented from rotating by two pins in the base cap arranged diametrically opposite and allowing these to engage slots in the baseplate cup. This setup obsoleted the wooden frame and permitted the use of the Stokes mortar bipod and breastplate described above for subsequent engineering tests.

The barrels E1 and E2, the first having 8 grooves, were discarded as having too much land area to permit proper engaging of the driving disk. Subsequent firings were done with barrels having 24 grooves, the lands being but one-sixteenth of an inch wide which gave good "take" or engraving of the driving disk. Barrel E3 proved to give the best results; however, it was necessary to change the groove form to increase the obturation (the effectiveness of the gas seal between the driving disk and the rifling of the barrel) to give a cleaner "take" and to reduce the wear on the lands. It was found that a uniform pitch in the rifling, as in the barrel E6, caused unstable flight and badly sheared driving disks. A similar result was experienced with a combination of semi-cubic parabola and uniform pitch. Barrels having pitches of one turn in 15 (barrels E4, E5, E6, and E7) gave excessive stability at the summit of the trajectory when using disk propellant, so that failing to nose over they impacted base first. Those barrels having pitches flatter than one turn in 20 calibers (barrels E8, E9, and E10) gave insufficient rotative speeds to provide the proper stability. When disk propellant was adopted in 1926, due to its non-hygroscopic and other qualities making it superior to other propellants, it was found that the barrel giving the best results was the E3 type having rifling form according to the semi-cubic parabola of 1 turn in 20 calibers at the muzzle.

The early period of development of the 4.2-in. chemical mortar is, for the purpose of this narrative, considered complete with the advent of the E3R1 barrel, the dug-in type baseplate (Fig. 25), the Stokes mortar tripod and the complete round shown in Figure 15. The mortar assembly designated M1 is shown in Figure 28, except that the baseplate here shown has a wing attachment which was discarded on the final model of this baseplate. The goal set for this mortar was attained in extending the range to 2500 yards. Part II of this narrative will continue with the development of a complete new mortar designed for an extension of the range to 4500 yards.

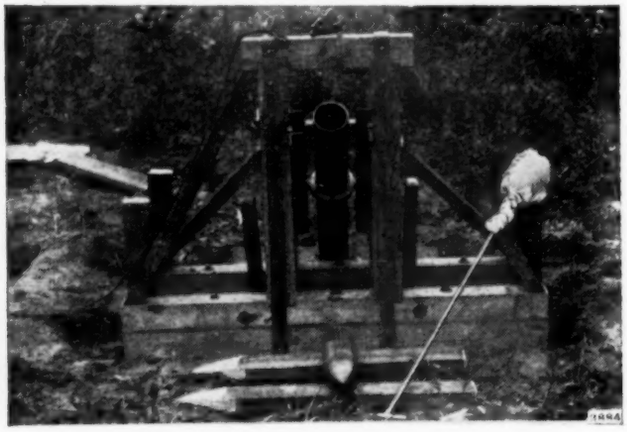

Figure 27
Experimental Firing Set-Up—Front View

Figure 28
4.2-inch Chemical Mortar M 1 With Wing Attachment on Baseplate

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NEW BOOK

ATOMIC ENERGY. Being the Norman Wait Harris Lectures Delivered at Northwestern University. Karl K. Darrow. 80 pages. John Wiley & Sons, Inc., New York, N. Y., and Chapman & Hall, Ltd., London, 1948. $2.00.

This book comprises a series of four one-hour lectures prepared especially for an audience made up of people whose main interests are in fields other than physics.

The first lecture reviews briefly the results of atomic energy research since 1913 and then proceeds with a discussion of atomic structure, including an explanation of such terms as electron, nucleus, charge, mass, weight, mass unit, isotope, proton, neutron, deuteron, alpha particle, and triton. In the second lecture, energy and atom "smashing" are discussed and the first example of the transmutation of the elements is presented. Transmutation is considered more at length in the third lecture and here it is pointed out that fission is the name for many processes and not the name for just one. The final lecture is concerned with questions bearing on the chain reaction and the fission process causing it. The difference between stable uranium and uranium isotopes 235 and 238 is explained and a description of the first pile constructed at the University of Chicago in 1942 are highlights of this lecture. The lecture concludes with a very lucid discussion of radioactivity.

Dr. Darrow is a well-known physicist who is now associated with the Bell Telephone Laboratories. He is Secretary of the American Physical Society and is the author of several books on physics. That he is eminently qualified to discuss atomic energy is attested by the excellence of this little book. Your reviewer, who is no nuclear physicist by any stretch of the imagination, feels better equipped to understand the scientific and popular literature on atomic energy after reading Dr. Darrow's book.

L. WILSON GREENE

Air Flow Characteristics of the Breather Pump

By JESS W. THOMAS
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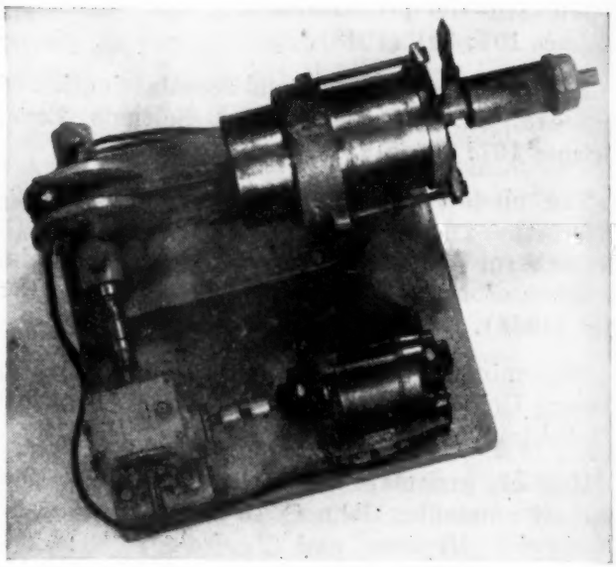

Figure 1
Breather Pump Used for Intermittent Flow Canister Testing

Introduction

An interesting phase of the routine evaluation of gas mask canisters and adsorbents is the calibration of the "breather" or sine-wave air pump, which simulates human respiration. The breather pump (Fig. 1) was developed soon after our entry into World War II by Division 10 of the National Defense Research Committee at Northwestern University, Chicago, Ill., and, with modification, was incorporated into the standard canister testing apparatus of the Chemical Corps.

The purpose of this paper is to describe the air flow characteristics of the pump, and to show that a simple modification of a conventional orifice-type flowmeter (submitted by N.D.R.C.) may be used to measure accurately peak instantaneous flows.

Prior to World War II, acceptance tests on U. S. Army canisters were specified to be made at a constant flow of 32 liters per minute. This figure was obtained from work done during World War I, and approximates the average breathing rate of a man at moderate exercise. However, testing canisters against gases at constant flow conditions does not reproduce the air flow conditions existing when canisters are actually in use. It was decided during World War II to require some of the acceptance tests of canisters and adsorbents to be made under more realistic air flow conditions. Accordingly the "breather pump" was developed and used.

The breather pump pulls air through the test canister intermittently, that is, for half a cycle no air is drawn through the canister, and during the other half cycle the flow through the canisters varies from zero to about 155 liters per minute. There are about 33 cycles per minute, and the total amount of air drawn through the canister in one minute is about 50 liters. The pump thus simulates the breathing of a man at heavy exercise.

Use of the breather apparatus and other work has shown that there are two important air flow factors affecting the performance of the canister: the peak air flow through the canister and the minute volume, or average flow of air through the canister. The term "minute volume" is used to indicate the total volume of air passing a given point over a period of several minutes divided by the time in minutes. The dimensions of the breather pump, of course, affect both the peak flow and minute volume.

The effect of these two factors may be stated more explicitly, that the life of the canister against some toxic gas at otherwise constant conditions is dependent upon (1) the total amount of air-gas mixture passed through the canister per minute and (2) the maximum instantaneous rate of flow of the air-gas mixture through the canister.

It was found, when testing canisters against one of the more important chemical warfare agents, that the maximum instantaneous flow rate was the controlling factor in the performance of the canister. This necessitated an accurate knowledge and control of the peak flow developed by the breather pump used in the canister testing apparatus. For measurement of the peak flow, a modification of an orifice meter proposed in O.S.R.D. Report 1872 was used.*

This device was developed by N.D.R.C., Division 10, for checking their breather pumps, and the device indicates the maximum flow rate by determining the maximum pressure drop developed across a standard orifice. It was decided to determine if the meter accurately indicated the

*Pierce, W. C., Zabor, J. W., and Smith, D. P., A Meter for Calibration of Breather Pumps. Office of Scientific Research and Development (O.S.R.D.), Report 1872, October 1, 1943.

true peak flow developed by the breather pump.

The problem was approached from two angles: (1) calculation of the maximum instantaneous flow and minute volume from the dimensions and the speed of operation of the pump, and (2) measurement of the above factors with the orifice meter and dry meter to determine if the measured values checked the theoretical values.

Theoretical

The breather pump is shown in Figure 1. A schematic diagram of the pump including the line to the canister under test is shown in Figure 2.

The check valves (1), (Fig. 2) permit air to be drawn through the canister, and force air expelled from the pump into the atmosphere. The protective canister (2) prevents any toxic gas escaping the test canister from entering the pump.

It is desired to calculate the minute volume and peak flow of the air entering the pump, Figure 2, as the crankshaft rotates. Referring to the figure,

(1) $(\chi - R\cos\theta)^2 + (R\sin\theta)^2 = L^2$

(2) $\chi = \sqrt{L^2 - (R\sin\theta)^2} + R\cos\theta$

Differentiating χ with respect to θ,

(3) $$\frac{d\chi}{d\theta} = -R\sin\theta - \frac{R^2\cos\theta\sin\theta}{\sqrt{L^2 - (R\sin\theta)^2}}$$

It is desired, however, to obtain $\frac{dV}{dt}$ where V is the volume of space developing in the cylinder and t is the time. Since $-dV = \frac{\pi D^2}{4} d\chi$ and $dt = \frac{d\theta}{2\pi f}$ where f is the number of cycles per minute,

(4) $$\frac{dV}{dt} = \frac{\pi^2 f D^2}{2}\frac{d\chi}{d\theta}$$

Substituting (3) in (4), equation (5) is obtained,

(5) $$\frac{dV}{dt} = \frac{\pi^2 f D^2 R}{2}\left(\sin\theta + \frac{R\cos\theta\sin\theta}{\sqrt{L^2 - (R\sin\theta)^2}}\right)$$

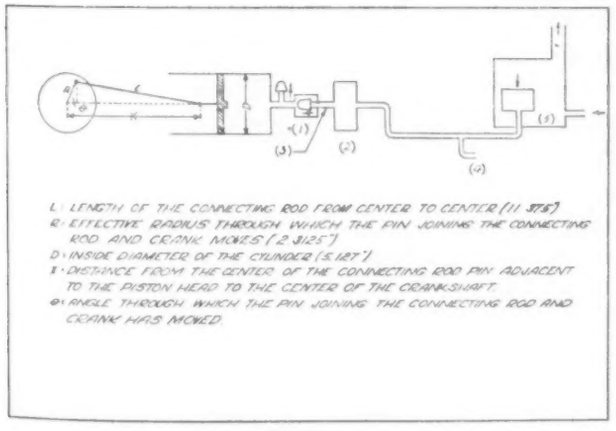
L: LENGTH OF THE CONNECTING ROD FROM CENTER TO CENTER (11 3/16")
R: EFFECTIVE RADIUS THROUGH WHICH THE PIN JOINING THE CONNECTING ROD AND CRANK MOVES (2 3/125")
D: INSIDE DIAMETER OF THE CYLINDER (5.187")
X: DISTANCE FROM THE CENTER OF THE CONNECTING ROD PIN ADJACENT TO THE PISTON HEAD TO THE CENTER OF THE CRANKSHAFT.
θ: ANGLE THROUGH WHICH THE PIN JOINING THE CONNECTING ROD AND CRANK HAS MOVED.

Figure 2
Schematic Diagram of the Pump and Connecting Air Lines

The right member of this equation consists of two parts. The second of these represents the deviation from the pure sine curve caused by the continuing change in angularity of the connecting rod, and vanishes for a connecting rod of infinite length.

The synchronous speed of the motor supplied with the breather pump was 1800 r.p.m., and the reduction gear has a ratio of 54 to 1, giving 33.33 r.p.m. as the value of f. Substituting in equation (5) the values of f, π, D, and R (Fig. 2), and converting to units of liters per minute, equation (6) is obtained:

(6) $$\frac{dV}{dt} = 163.9\left(\sin\theta + \frac{R\cos\theta\sin\theta}{\sqrt{L^2 - (R\sin\theta)^2}}\right)$$

Plotting $\frac{dV}{dt}$ against θ, Figure 3, the solid line, a maximum of 167.4 liters per minute is obtained, which would represent the peak air flow into the pump cylinder under idealized conditions. The minute volume flowing into the pump cylinder under ideal conditions is obviously equal to the inside area of the cylinder multiplied by the length of stroke and the number of strokes per minute,

$$\left(\frac{\pi D^2}{4}\right)\left(2R\right)\left(f\right) = 52.2 \text{ liters}$$

per minute. Graphical integration of equation (6) over a sufficient number of cycles gives a minute volume of 52.3 liters per minute, which is in quite satisfactory agreement. This equation will not be modified to represent conditions actually existing when the orifice meter is used to measure peak air flows.

The orifice meter is shown diagrammatically in Figure 4. When the meter is attached to the point marked (3), Figure 2, in order to measure the peak air flow of the pump, a considerable pressure drop, ΔP, occurs across the meter. This pressure drop was measured and found to be 64.5 mm. of water at a flow of 85 liters per minute at 760 mm. mercury pressure. As the pump operates, this pressure drop will vary as the air flow into the pump varies.

In order to develop the equation for the case where the orifice is placed at (3), Figure 2, the following approximations are made:

1. For a given orifice, the pressure drop, ΔP, of the orifice is proportional to the square of the weight rate of air flow through it, and that there is no further pressure drop between the orifice and the moving piston of the cylinder. (The valve shown at (1), Figure 2, has a very low resistance.)

2. The effect of the dead air space is negligible.

3. The resistance of the check valve of the orifice meter is negligible.

Equation (7) is obtained by considering that the flow of air in liters per minute into the pump measured at a pressure of 760 mm. of mercury, F, is equal to the rate of change of volume developing in the pump times a factor correcting for the expansion of air across the orifice.

$$(7)\quad F = \frac{dV}{dt}\left(\frac{760 - \left(\frac{F}{85}\right)^2 \Delta P_{85}}{760}\right)$$

Substituting in the numerical value of P in mm. of mercury and simplifying gives equation (8),

$$(8)\quad F = \frac{dV}{dt}\left(1 - \frac{F^2}{1{,}100{,}000}\right)$$

The second term in equation (8) is always small compared to the first term. Calculation showed that $\frac{dV}{dt}$ may be substituted for F with a final effective difference of less than 0.1%. This gives equation (9):

$$(9)\quad F = \frac{dV}{dt}\left(1 - \frac{\left(\frac{dV}{dt}\right)^2}{1{,}100{,}000}\right)$$

Equation (9) is plotted in Figure 3. The maximum flow taken from the graph is 163.0 liters per minute. This is the flow of air, measured at atmospheric pressure, delivered through an orifice having a resistance of 64.5 millimeters of water at a constant flow of 85 liters per minute. Equation (9) integrated graphically gave a minute volume of 50.7 liters per minute. This would be the flow obtained if a dry meter were connected to the orifice which in turn is directly attached to the pump.

Equation (9) was developed on the assumption that the dead air space was negligible. This condition is approximated when the orifice is inserted directly at the pump (3), (Fig. 2).

For purposes of comparison, an ordinary sine curve is included in Figure 3. This is the air flow which would be obtained with a breather pump of the same dimensions as the standard model but with a connecting rod of infinite length and the use of a noncompressible fluid.

In order to use the orifice meter to check the theoretical maximum air flow, 163.0 liters per minute, above, it was first necessary to determine the effect of the orifice meter valve resistance and leakage. To facilitate discussion of these factors, a description of the orifice meter and its use is now given.

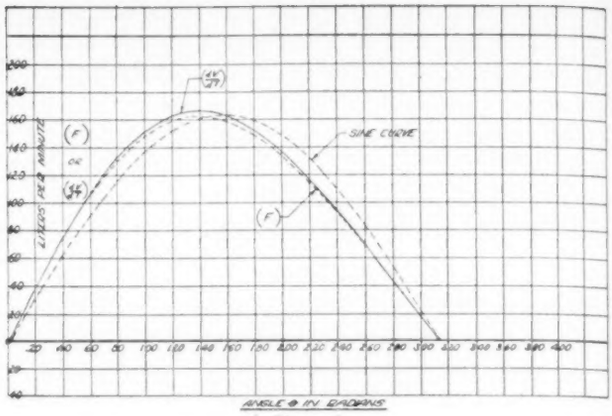

Figure 3

Theoretical Rate of Air Flow Developed by Pump

Use of the Orifice Meter

Referring to Figure 4, the open end of the orifice meter (1) is attached to the point where a peak flow measurement is desired. When the breather pump is operating, air enters the orifice at (2), undergoes a pressure drop, and leaves via the end (1) to the line and pump. The side arm (3) contains a valve within the metal housing (4) which permits air to be drawn from the surge bottle (6) but does not permit the air to return to the bottle. The water manometer (5) indicates the amount of vacuum developed. The stopcock (8) permits air to be drawn into the bottle by the pump until temperature equilibrium is attained, shown by thermometer (7).

As the breather pump operates, the valve will open as long as the pressure on the outlet side of the valve is less than the pressure within the surge bottle. The pressure on the outlet side is continuously varying from atmospheric to some maximum negative value. Thus, as the pump operates, more and more air will be drawn from the surge bottle (stopcock) (8) being closed) until finally the pressure in the surge bottle reaches some maximum negative value. This value corresponds to the maximum pressure drop across the orifice, hence is a measure of the peak flow through the orifice. This pressure drop is then compared with the values obtained from the constant flow calibration of the orifice, to determine if the pump is giving the required maximum peak flow.

The necessary capacity of the surge bottle (6) has not been critically determined, but bottles of from one to four liters have been used successfully. The valve (9), Figure 4, is a standard U. S. Army facepiece outlet valve. The valve consists simply of a thin disc of rubber mounted centrally on a perforated plastic seat. A pressure drop across the valve causes the edges of the thin rubber disc to rise, allowing air to pass

through the perforated seat and by the edges of the disc. A pressure drop in the opposite direction causes the valve to seat tightly.

Effect of Variable Factors on Orifice Meter

In order to determine the effect of leakage of the orifice meter valve (9), Figure 4, a number of valves having different leakages were used on the same orifice meter and breather pump. The leakage was determined by developing a differential of about 10 cm. on the surge bottle (6), (Fig. 4), then shutting off the pump and observing the drop in the manometer in centimeters per minute. From the pressure drop and the capacity of the surge bottle, the leakage in milliliters per minute was calculated. The results are given in Table I.

TABLE I

Effect of Valve Leakage on Differential of Orifice

Valve leakage, cm./min. at a differential of 10 cm.	Leakage converted to ml./min.	Orifice differential in cm./H_2O
0	0	26.4
3	15	26.2
3	15	26.3
5	25	26.1
15	75	26.0

It was also necessary to determine the effect of the resistance of the valve to the flow of air. The resistance of the valves were first determined on the standard orifice meter and then the valves were interchanged on the same pump. The results are given in Table II.

TABLE II

Effect of Valve Resistance on Differential of Orifice

Resistance of valve at 85 l./min.	Valve leakage at a differential of 10 cm.	Valve leakage, ml./min.	Orifice differential in cm./H_2O
24	1 cm./min.	5	25.6
30	½ cm./min.	2½	25.6
43**	4 cm./min.	20	25.5
90**	4 cm./min.	20	23.7
180**	½ cm./min.	2½	18.6*

*Approximate, due to high resistance of valve.

**High resistances obtained by using double valves etc.

In order to minimize the effect of these factors, subsequent data were determined with valves having resistances of less than 30 mm. measured at 85 liters per minute and leakages of less than 15 milliliters per minute measured at a differential of 10 cm.

Peak Flow Measurements With Orifice Meter

To check equation (9), which gives the flow of air through the orifice meter when the meter is directly attached to the pump, a number of measurements were made on several of the pumps in the laboratory. The orifice meter in every case gave maximum pressure drops of from 25.0 to 26.4 cm.

According to the constant flow calibration chart on page 3 of the N.D.R.C., Report 81, the differential for this orifice for the calculated peak flow of equation (9) (163.0 liters per minute) was 25.7 cm.

To determine the effect of the protective canister in the line (2), (Fig. 2), four standard U. S. Army canisters were made up, one entirely empty and the others having resistances of 11, 28 and 57 mm. at a flow of 85 liters per minute. The pump was then tested by placing the canister about 6 in. from the pump. The orifice meter was then attached to the canister.

TABLE III

Effect of Protective Canisters on Differential of Orifice

Canister resistance at 85 l./min.	Orifice differential reading, cm./H_2O	Average
Empty canister	24.6	
" "	24.6	
" "	24.3	24.55
" "	24.7	
" "	24.5	
11	24.5	
"	24.6	
"	24.6	24.55
"	24.4	
"	24.7	
28	24.2	
"	24.4	
"	24.3	24.35
"	24.5	
"	24.3	
57	24.0	
"	24.1	
"	23.7	23.85
"	23.8	
"	23.7	
70 (smaller canister)	23.5	
" " "	23.8	
" " "	23.9	23.70
" " "	23.7	
" " "	23.6	
No canister	25.2	
" "	24.8	
" "	25.1	25.05
" "	25.0	
" "	25.1	

The effect of the length and type of connecting hose was also determined on several testing machines (Table IV). The one-inch hose had a stiff outer wall about ¼ in. thick. The facepiece hosetube was the standard corrugated type used on gas masks. The orifice was placed at the end of the hose in each case, except the last, where it was placed in the chuck of the canister holder.

TABLE IV

Effect of Hose on Orifice Differential

Amount and type of hose	Orifice differential, cm./H_2O 1st breather pump	2nd breather pump
None (at pump)	26.3	25.9
5 ft. facepiece hosetube	—	25.3
5 ft. 1-inch hose	26.0	25.6
11 ft. 1-inch hose	25.5	25.3

The sensitivity of the test to leaks was determined as follows. A leak was simulated by opening a side line (4), (Fig. 2) in the connecting hose and adjusting the amount of leakage by means of a screw clamp. The amount of leakage was recorded by a wet meter. The orifice meter was placed at (5), Figure 2. The figures in the net flow column were obtained by subtracting the leakage from the total flow in liters per minute, which is assumed to be the same in every case.

TABLE V

Effect of Machine Leakage on Differential of Orifice

Leakage, l./min.	Net flow, l./min.	Orifice differential cm./H_2O	Maximum flow (chart), l./min.
0	50.7	25.4	162
1.14	49.6	24.0	158
2.04	48.7	23.2	156
3.44	47.3	20.8	147
6.33	44.4	18.6	143

Discussion and Conclusions

In several instances, during this study, one or another of the breather-type canister test machines used for routine testing began to show erratic results. Each time, the pump was checked with the orifice meter and was found to give a reading below 23 cm. of water pressure differential. The pumps were dismantled, the packing tightened up, and leaks eliminated. In all cases the readings came back up to about 25 or 26 cm.

The orifice was also checked by developing a high pressure differential on the surge bottle manometer and then allowing it to drop (due to slight valve leakage) to a constant value. This final value was found to be the same as that obtained under normal use.

The results of the test on orifice meter check valves permit the determination of critical limits on orifice valve leakage and resistance. Valves having less than 15 milliliters per minute leakage at a differential of about 10 cm. and resistances of less than 30 mm. measured at 85 liters per minute are indicated as being satisfactory.

Referring to the results of the tests on the effect of volume and resistance on the orifice differential, it will be noted that an empty Army canister (volume, with stopper, about 120 cu. in.) caused a drop of 0.50 cm. in the orifice differential, and 11 ft. of one-inch hose (volume, 105 cu. in) caused an average drop of 0.70 cm. Hence,

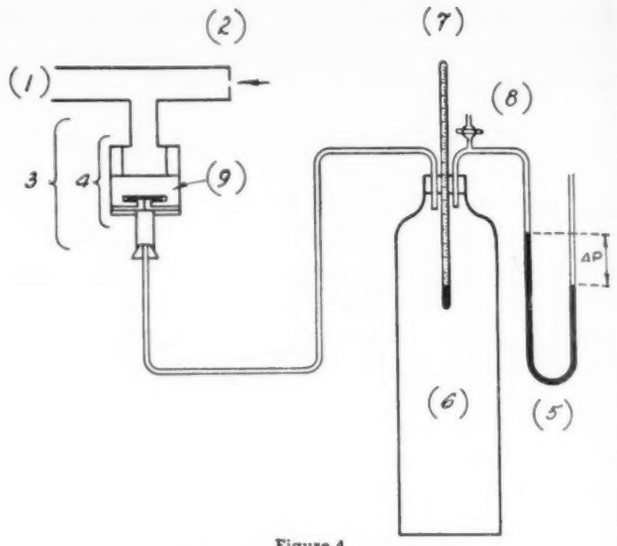

Figure 4
Orifice Meter and Apparatus.

it seems that the volume of the protective canister is at least as great a factor as its resistance in reducing the peak flow rate. The results of the resistance test, incidentally, show that in some cases an accuracy of better than ± 3 mm. of water cannot be expected in the readings.

The results of the sensitivity-to-leakage test show that the minute volume and the maximum instantaneous flow rate drop off roughly in the same proportion when the drop is due to leaks. That is, a 5% drop in the peak, or maximum instantaneous flow rate represents an approximate drop of 5% in the minute volume. This 5% drop will appear on the orifice differential as a 10% drop, since the pressure drop across the orifice is proportional to the square of the air flow.

More explicitly, if F is the air flow into the orifice, and ΔP is the pressure drop across the orifice, the following relation approximately holds for small differences in flow and pressure drop:

$$F^2 = K(\Delta P)$$

$$2FdF = Kd(\Delta P)$$

$$\frac{2FdF}{F^2} = \frac{Kd(\Delta P)}{K(\Delta P)} \text{ or } 2\frac{dF}{F} = \frac{d(\Delta P)}{(\Delta P)}$$

Hence $\frac{d(\Delta P)}{(\Delta P)}$, the change in pressure drop divided by the original pressure drop, which represents the percentage change in pressure drop, is double $\frac{dF}{F}$, which represents percentage drop in flow.

From a theoretical viewpoint, the calculated peak flow of 163.0 liters per minute through the orifice meter, equation (9), which equals a differential of 25.7 cm. (from the constant flow calibration of the meter), checked closely with the actual values obtained using the orifice meter (25.0 to 26.4 cm.). Also, in routine calibration of the breather pumps at the Army Chemical

Center, using dry meters, the usual value of the minute volume was from 50 to 52 liters per minute. This checks the calculated value from equation (6), which applies here, probably within the limit of error of the dry meter.

In addition, other orifice meters similar to the one herein described have been made by the Technical Command, and it has been found that the observed peak flows, as shown by the meters, check theoretical values closely.

It is therefore concluded that orifice meters with check valves, although calibrated under constant flow conditions, may be used under variable flow conditions to obtain the true peak flow, since the peak flow measured experimentally corresponded very closely with the calculated value.

Summary

The air flow characteristics of the breather pump used for testing gas mask canisters have been described. The maximum instantaneous, or peak, air flow developed by the pump, which is intended to simulate human breathing, is about 160 liters per minute. The average flow of air developed by the pump is about 50 liters per minute. An orifice meter having a check valve, developed by Division 10, N.D.R.C., and calibrated at constant flow, has been used to determine the peak flow. The peak flow as obtained by the orifice meter shows very good agreement with the peak flow as calculated from the dimensions and rate of operation of the pump.

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Anhydrous, Liquid

Chromate of Soda
Anhydrous, Liquid

Ammonium Bichromate

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  Chief, Chemical Corps
- Colonel E. C. Wallington, CmlC
  Deputy Chief
- Major J. O. Quimby, CmlC
  Executive
- Colonel H. M. Black, CmlC
  Chief, Supply and Procurement Division
- Colonel J. C. MacArthur, CmlC
  Chief, Plans, Training and Intelligence Division
- Colonel W. M. Creasy
  Chief, Research and Engineering Division
- Col. Leonard J. Greeley, CmlC
  Assistant Deputy for Management
- Col. William J. Bacon, JAG
  Legal Advisor
- Lt. Col. John J. Hayes, CmlC
  Chief, Budget and Fiscal Office
- Col. Ralph C. Benner, CmlC
  Chief, Military Personnel Branch

Army Chemical Center, Maryland
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  Commanding General
- Colonel R. T. Beurket, CmlC
  Deputy Chief
- Colonel G. Marshall, CmlC
  Commandant, Chemical Corps School
- Colonel J. A. MacLaughlin, CmlC
  Commanding Officer, Technical Command
- Colonel H. W. Rowan, CmlC
  President, Chemical Corps Board

Camp Detrick, Frederick, Maryland
- Major H. J. Isbell, CmlC
  Commanding Officer

Huntsville Arsenal, Huntsville, Alabama
- Colonel J. M. McMillin, CmlC
  Commanding Officer
- Lt. Colonel A. H. Williams, CmlC
  Executive Officer

Pine Bluff Arsenal, Pine Bluff, Arkansas
- Colonel W. A. Copthorne, CmlC
  Commanding Officer
- Major L. E. Anderson, CmlC
  Executive Officer

Rocky Mountain Arsenal, Denver, Colorado
- Colonel A. St. John, CmlC
  Commanding Officer
- Lt. Colonel J. P. Tolman, CmlC
  Executive Officer

San Jose Project, Office, Chief, Chemical Corps, St. Thomas, Virgin Islands, BWI
- Colonel L. E. Elliott, CmlC
  Commanding Officer
- Colonel N. D. Gillet, CmlC
  Executive Officer

Western Chemical Center, Tooele, Utah
- Colonel P. F. Powers, CmlC
  Commanding Officer
- Lt. Colonel W. S. LeRoy, CmlC
  Executive Officer

Chicago Chemical Procurement District, 226 W. Jackson Blvd., Chicago, Illinois
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  Commanding Officer

Dallas Chemical Procurement District, 1114 Commerce St., Dallas 2, Texas
- Major A. C. Hamilton, CmlC
  Commanding Officer

New York Chemical Procurement District, 111 E. 16th St., New York 3, New York
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  Commanding Officer

San Francisco Chemical Procurement District, Oakland Army Base, Building 1, Wing 3, Oakland 14, California
- Colonel S. E. Whitesides, Jr., CmlC
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- Colonel R. E. Johnson, CmlC
  Chemical Officer

Headquarters, First Army, Governors Island, New York 4, New York
- Colonel J. R. Burns, CmlC
  Chemical Officer

Headquarters, Second Army, Fort George G. Meade, Maryland
- Colonel P. R. Smith, CmlC
  Chemical Officer

Headquarters, Third Army, Fort McPherson, Georgia
- Colonel R. B. Strader, CmlC
  Chemical Officer

Headquarters, Fourth Army, Fort Sam Houston, Texas
- Lt. Colonel R. O. Gordon, CmlC
  Chemical Officer

Headquarters, Fifth Army, 1660 East Hyde Park Boulevard, Chicago 15, Illinois
- Colonel H. B. Bramlet, CmlC
  Chemical Officer

Headquarters, Sixth Army, Presidio of San Francisco, California
- Colonel C. M. Kellogg, CmlC
  Chemical Officer

Chemical Corps Officers Reserve Corps Instructors

First Army Area
- Captain J. N. Klein, CmlC
  Office of the Senior State ORC Instructor, 90 Church St., New York 7, New York
- Lt. Colonel F. A. Rohrs, CmlC
- Captain K. J. Wilson, Cml C
  Office of the Senior State ORC Instructor, Post Office Building, 402 E. State St., Trenton, New Jersey

Captain W. J. McDermott, CmlC
Office of the Senior State ORC Instructor, Post Office Box 646, 726 King St., Wilmington 99, Del.

Third Army Area

Lt. Colonel L. W. Duerner, CmlC
Alabama ORC Instructors, 708 Frank Nelson Building, Birmingham, Alabama

Fourth Army Area

Major C. F. Evans, CmlC
Office of the Senior Instructor, ORC, State of Louisiana, New Orleans, Port of Embarkation, New Orleans, Louisiana

Fifth Army Area

1st Lt. R. J. Schram, CmlC
Illinois State Senior Instructor, ORC, 1660 East Hyde Park Blvd., Chicago 15, Illinois

Captain S. T. Bonds, CmlC
Minnesota State Senior Instructor, ORC, 310 Federal Office Building, Third and Washington Aves., S, Minneapolis, Minnesota

Major C. H. White, CmlC
Missouri State Senior Instructor, ORC, 12th and Spruce Sts., St. Louis 2, Missouri

Sixth Army Area

Lt. Colonel A. M. Dunn, CmlC
Northern California-Nevada ORC Instructor Group, Presidio of San Francisco, California

Captain E. F. Them, CmlC
Washington State ORC Instructor Group, Room 1606, Textile Tower, 7th Avenue and Oliveway, Seattle 1, Washington

ROTC Instructors

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Major J. C. Braxton, CmlC
Instructor

ROTC, Purdue University, Lafayette, Indiana
Lt. Colonel L. B. Cottingham, CmlC
Instructor

ROTC, Agricultural and Mechanical College, College Station, Texas
Major A. O. Wiken, CmlC
Instructor

ROTC, Georgia School of Technology, Atlanta, Georgia
Lt. Colonel N. I. Decker, CmlC
Instructor

ROTC, Massachusetts Institute of Technology, Cambridge, Massachusetts
Lt. Colonel J. W. Fitzpatrick, CmlC
Instructor

Foreign Service—Theater Chemical Officers

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Chief Chemical Officer

Headquarters, U. S. Army, Far East Command
Colonel D. R. King, CmlC
Chief Chemical Officer

Headquarters, U. S. Army, Pacific
Lt. Colonel R. W. Breaks, CmlC
Chief Chemical Officer

Headquarters, U. S. Army, Caribbean Command
Lt. Colonel J. S. Terrell, CmlC
Chief Chemical Officer

Headquarters, U. S. Army, Alaska
Major H. B. Webster, CmlC
Chief Chemical Officer

Major Department of the Air Force Installations (Chemical Officers)

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Air Chemical Officer

Headquarters, Air Materiel Command, Wright-Patterson Air Force Base, Dayton 1, Ohio
Lt. Colonel D. R. Keefe, USAF
Air Chemical Officer

Headquarters, Tactical Air Command, Langley Field Air Force Base, Virginia
Lt. Colonel T. J. Cummins, USAF
Air Chemical Officer

Air Chemical School, Keesler Air Force Base, Biloxi, Mississippi
Lt. Colonel C. H. Breedlove, USAF
Commanding Officer

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Air Chemical Officer

Headquarters, Far East Air Force
Colonel R. D. McLeod, Jr., CmlC
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The Pemco War Story

By G. H. SPENCER-STRONG,
Vice President and Director of Research

In 1917, when World War I began, the company now known as Pemco Corporation was just six years old. Being then principally engaged in porcelain enameling, the items made for the Services consisted chiefly of hospital equipment; for instance, porcelain enameled operating tables, trays and pans for the operating rooms and beds, and the conventional utensils one would expect to find in a hospital ward. While over two decades had elapsed, the management had only too vivid a recollection of the trials and tribulations of a company that ordinarily made only peacetime items, not to become concerned over what it would do if the war clouds hanging over Europe were to result in actual fighting.

It was in the middle part of 1938 that the management decided it was not too early to try and determine what it could manufacture if an actual conflict broke out. A request for a survey of facilities by the Army and Navy resulted in the sending of mobilization planning men to inspect the plant at Baltimore by the Engineers Corps, the Quartermaster Corps and the Chemical Warfare Corps. The report from each of these was not too encouraging; the facilities available did not seem to lend themselves to the production of items ordinarily needed by the Services. The classification given Pemco was that of a secondary supplier who would in all likelihood be called upon to accept subcontracts from prime contractors.

One very favorable observation, though, was that the company had extensive laboratory and research facilities. It was thought that through this channel some type of activity not yet foreseen might be developed. Taking this as a cue, a visit was made to the Army Chemical Center, just 20 miles from our plant, to discuss with their technicians the possible ways in which Pemco might be of help in the event of war.

It so happened that Chemical Warfare Service at that time was producing a large number of gas masks, for which there was a considerable demand for soda lime to be used in the canisters of these masks. At the same time, it was pointed out that no substantial improvement had been made in soda lime since the first World War, though a much more efficient absorbent was very much to be desired. Army specifications and directives for the manufacture of soda lime were obtained and the Pemco laboratories launched a program to develop an improved product. As progress was made a small pilot plant was set up to facilitate our experiments.

The first soda lime produced in this small pilot plant was only equal to the government specifications. However, as experience was gained, improved absorbing qualities were developed. In the fall of 1939, with fighting having actually broken out in Europe, the government accelerated its gas mask program and required large quantities of soda lime. Pemco was invited to bid on part of the requirements and was awarded a contract. Full scale production facilities were installed and within a few months production schedules were being regularly met. By the spring of 1940 the demand for soda lime had increased to such an extent that original capacity was doubled. In the meantime, as a result of extensive experiments in both the laboratory and in production, the efficiency of absorption of soda lime was increased tremendously while, at the same time, lower costs resulting from greater production enabled the government to purchase its requirements at a considerable saving over its original estimates. Later in the war, activated charcoal replaced soda lime as a principal absorbent in gas mask canisters and the Pemco soda lime department was held in stand-by condition except for occasional short periods when operations were resumed to produce medical soda lime for the office of the Surgeon General and for the Navy who, incidentally, not alone used the soda lime for hospital purposes but also placed it in all submarines to be used to revitalize the air in the submarines in the event it became impossible to surface and take in fresh air.

In the summer of 1941 when, as a part of its preparedness program, the government began manufacturing incendiary bombs, additional sources of the principal ingredient—thermit—were required. This material, although long known and fairly widely used as a metallurgical product in the production of thermit welds, had never been previously produced in large quantities in the United States for military purposes. Having proven, through its ability by the results obtained in the soda lime program, Pemco was one of the first invited to make thermit under government contract. All during that summer and early fall pilot plant experiments were made in the production of thermit and suitable sources of supply of the necessary materials were established. In this regard the company was exceedingly fortunate in being closely located to the Sparrows Point plant of the Bethlehem Steel

Company from which a particular grade of mill scale, which comprised about 70 percent of the weight of thermit, was obtained.

Exactly 10 days before Pearl Harbor, along with several other manufacturers, Pemco was awarded a large contract for the manufacture of thermit. War seeming to be imminent, one of the conditions of the contract was that deliveries would begin by January 1, 1942, which gave just a little more than 30 days in which to build a plant. In this short period, a building was erected and equipment installed, and on the second day of January the first thermit was produced.

Needless to say, no one in the Pemco organization had a holiday that year except for a few hours on Christmas Day. By the time another two months had rolled around, this new thermit plant was so completely mechanized that the operation became practically continuous except where safety regulations forbade.

The original installation, part of which was ready for operation in January, 1942, consisted of large rotary calcining furnaces for treating the iron scale, cooling and screening the equipment, and ten 200-pound double cone blenders. Numerous experiments as to the most efficient method of blending the ingredients led to the conclusion that cone blender with proper baffles produced the most satisfactory results with the least possible hazard of explosion.

The thermit operation continued during the full course of the war and the installation was continuously improved, as may be seen by comparison of the labor requirements of the original unit with those of the final installation. The original unit required more than 30 men per 8-hour shift whereas, with the final installation, less than 10 men produced considerably more material.

As both the chemical and physical properties of the material that went into the manufacturing of thermit were important, the problems were numerous. However, the continuous method of manufacturing, because of its inherent uniformity, minimized these problems to such an extent that other manufacturers of thermit using batch methods, at the request of the government inspected the facilities and, as rapidly as they could, changed their own plants to duplicate the Pemco system.

The company is proud of the record of this unit. Although it was the largest single thermit producing unit in the United States, and in spite of the numerous changes in specification requirements necessitated in the first year of its operation, this unit never lost a single batch of thermit through government reject during the entire course of the war. This record was in large part made possible by a close system of control of all phases of the operation, including the raw materials.

While the oil bomb produced later in the war reduced the amount of thermit required, the Pemco facilities were almost continuously producing until the end of the war was in sight, and the production on all munitions was cut back.

With the complete cessation of civilian production in the summer of 1942, Pemco cleared the equipment from a large part of its plant and set up for the manufacture and loading of HC Smoke Pots. As Pemco's production facilities for many years prior to the war had been of the continuous type, it was very logical that in setting up this loading plant, wherever possible continuous procedures were used. Except for the mixing operations themselves, which were extremely dangerous and had to be conducted in small fire and explosion-proof cubicles, the entire operation of loading and packing smoke pots was mechanized and conveyorized—even the weighing of increments was done by automatic scales, though this practice had to be discontinued early because it was found that automatic weighing was not safe after quite a few small fires broke out in the automatic scales. While they resulted in very little serious property damage, they did disrupt production and unnecessarily frightened the operators. After hand weighing was resorted to, there was no further difficulty from this source.

From the beginning of the operation the containers were carried on conveyors, except when occasionally they had to be removed for some special operation, and they progressed continuously through the plant—sometimes on roller conveyors, sometimes on belt conveyors, and sometimes on overhead chain conveyors, depending upon the operation. The layout was so designed that at no point was there sufficient storage room to accumulate production. This was done purposely—first to make it necessary that the production line keep moving, and for another more important reason, that of safety. By keeping the smoke pots on the conveyor, there were never enough at one particular place to constitute a serious hazard in case of an accident, explosion or fire. When the smoke pot program was at its peak, over 1,400 men and women were employed at the Pemco plant, and it required the unloading or loading of some 22 railroad cars a day. Without mechanization, this volume would never have been possible.

The only serious accident at the Pemco plant during the war occurred in the press room and resulted in sending about 20 people to the hos-

pital, two of whom died. And a very important lesson in the design of loading plants was learned. In order to maintain a relatively high humidity in the loading and mixing room to eliminate the possibility of static sparks that might cause the smoke powder to catch fire or explode, the company was required to install a rather extensive air-conditioning system. The fatal mistake was that in the name of economy of scarce war materials, all the ducts of this system were connected together. Consequently, when one of the mixing machines housed in its explosive-proof cubicle caught fire one afternoon, the resultant smoke and poisonous fumes were drawn into the air return system and promptly blown through the air-conditioning ducts to every point in the plant. Only those with experience can appreciate the volume of smoke even a small amount of smoke mixture can produce. When hundreds of pounds were burning at one time, the density of the smoke naturally was terrific and in a few seconds the entire plant, owing to the excellent distribution features of the air-conditioning system, was engulfed in a smoke so thick that the operators could not find their way to open doors or windows only a few feet from where they stood at their machines. The fire itself was confined to the cubicle in which it started and as soon as the air-conditioning fans could be shut down and the building partly cleared of smoke, with the aid of gas masks a search was made of the building. Only two employees had been unaccounted for. The machine at which they had been working was less than 10 feet from an open door, but in the dense smoke they had wandered deeper into the building and were suffocated.

As a result of this accident the Safety Division of the Chemical Warfare Service ruled that continuous air-conditioning systems should not be generally used except where elaborate automatic safety cutoffs were installed, and that in all future installations each department should have its separate air-conditioning system.

One would hardly expect that a woman, drawing upon her experience as a housekeeper, would be able to make a very valuable suggestion to the Service. However, this very thing happened. One particular type of smoke pot required that industrial adhesive tape be wrapped around the upper edge of containers which were cylindrical in shape. The tape had to lap over the sides and the top. Anyone who has ever tried something of this sort has found that when the tape was neatly stretched around the side of a cylindrical shape, there was an excess of material to be folded over on the circular top. As the object was to make the seam water-tight, the small folds of excess material all but defeated the objective. After months of struggling with the problem, and calling upon the best technical brains at Edgewood Arsenal for a solution, one of the women operators, recalling that a seamstress always used bias cut tape in making dresses in order to overcome just such a problem, suggested that the industrial tape being used be cut on a bias. This was such a simple solution that it seemed ridiculous, particularly after all of the failure of the experts, and it was with considerable reluctance and only after much prodding that a trial was made. It took only a few minutes' experimenting, however, to prove that the lady's suggestion was sound, and immediately the search was on to find industrial adhesive tape cut on the bias. This one little suggestion was so important and so perfectly solved the problem that bias cut tape very shortly was generally specified by the military all over the country where similar problems prevailed. A bottleneck was broken and one woman operator was able to do as much work as 12 others with no additional cost of raw materials. This contribution on the part of a patriotic housewife doing her best in industry received recognition from both the Service and the management, with proper awards.

The Pemco Smoke Pot plant operated at full capacity until the famous cutback when, shortly before the Battle of the Bulge in Europe, the war seemed to be about over. Production was resumed immediately it became apparent that a lot more fighting was in prospect before all resistance would cease and continued up to within a month or two of VJ-Day.

While production schedules varied a great deal owing to the changing needs of the Service, Pemco's total production of smoke pots considerably exceeded that of any other manufacturer.

Other war work engaged in by Pemco consisted of the revitalizing and repacking of silica jel, packing of foodstuffs, the manufacture of parts for gas masks, the experimental production of flash simulators for the Navy and Ordnance Departments and, as a result of the company's own experiments, new and less expensive fire retardants were developed for treatment of military fabrics such as used for tents, tarpaulins, etc. Considerable work was also done in the development of special ceramics to be used as insulators for the high frequency instruments of the Signal Corps and the production of ceramic coatings for metals to increase the resistance to high temperatures in airplane and tank manifolds and submarine exhaust tubes, and for the treatment of ladles and stirring devices for handling molten alloys.

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CHAPTER NEWS

BALTIMORE CHAPTER

The Baltimore Chapter will have its first meeting, after the summer recess, on September 30. We expect an enthusiastic session, meeting old friends and, anticipating new members, will extend to them a most hearty welcome.

During the coming season we shall have as our guest speakers a member of the Federal Bureau of Investigation, a columnist who has just returned from Palestine, and an Army officer to tell us something about biological developments. Our future meeting dates have not been selected at this time but we shall have them announced at an early date. Members of sister chapters are always welcome and the "glad hand" of friendship is hereby extended to all who may be passing this way. If you come to Baltimore, just give us a ring and we shall be pleased to make your visit with us not only profitable but pleasant. Under present world conditions there is much to be done and we need the wholehearted cooperation of every member of the Chemical Corps in the work ahead of us. Come in to see us.

JAMES H. PYLE, *Sec'y-Treasurer*

CAMP DETRICK CHAPTER

Monthly conferences to discuss chapter plans and policies for the current year have been held by the officers of the Camp Detrick Chapter. The committee in charge of meetings plans to hold quarterly gatherings at which guest speakers will address the membership. It is hoped that the first meeting will be held during October. The War Plans and Mobilization Committee is working on a pertinent problem and will report upon completion of its survey in the field. It is planned by the membership committee that a concerted drive for members will be initiated during the fall months and it is believed that many new members will be obtained when they are informed of the aims, purposes, and policy of the Association. The officers believe that a highly active chapter can be maintained at Camp Detrick, ready to support at all times any obligations which the national association wishes to undertake.

MORRIS GUGGENHEIM

CHICAGO CHAPTER

Now that the heat of the summer is ended, it has been replaced by the application of heat in

the Chicago Chapter of the Armed Forces Chemical Association. The fireman of this local stoking proposition is the Chapter President, Charles E. Glennon. The success of any organization is the number of active, participating members. Members are what President Glennon wants, and members he is getting. But this isn't just by chance. During the summer he has laid down a program for stimulating the present members, and the obtaining of new ones. He feels that the well-informed chapter is the active chapter. To properly sell a product, the salesman must be thoroughly familiar with his product. To augment knowledge about the Chemical Association the sale of that authoritative work, "Chemical Warfare Service in World War II," is being pushed. With this additional information, the present members adopt a more informed, positive approach when they sell prospects on the advantages of being a member of the organization. Many times over experience has proven that when a potential member has been fully informed about the Association and what it stands for, that he just naturally signs the blank and enters into an active participation.

The membership drive itself is a well-thought out campaign directed to obtaining members in all the various categories. Committees have been set up for the subsections Industrial, Regular, Group, Military and Reserve, and Student. Literature is being assembled, correspondence composed, and publicity channels established with a goal of two hundred new members by Christmas. And the march to this goal already is under way. In all likelihood all of the personnel of the Chicago Chemical Procurement District will be on the rolls by the first meeting in October. The Stewart Die Casting Company, a division of the Stewart-Warner Corporation, is number one for a Group membership. Captain George McElroy, a reserve officer on extended active duty, leads off for the Military. Mrs. Floren Hamilton, a wartime employe of the local Procurement District, very familiar with the chemical industry in Chicago, and now with Headquarters Fifth Army, is representative of interested civilians. Mr. Morton Hague, Vice President of Hoosier Industries, Inc., La Porte, Indiana, prominent business and club man, is a valuable addition as an industrialist. All of these people have joined the Association with an active interest and are ener-

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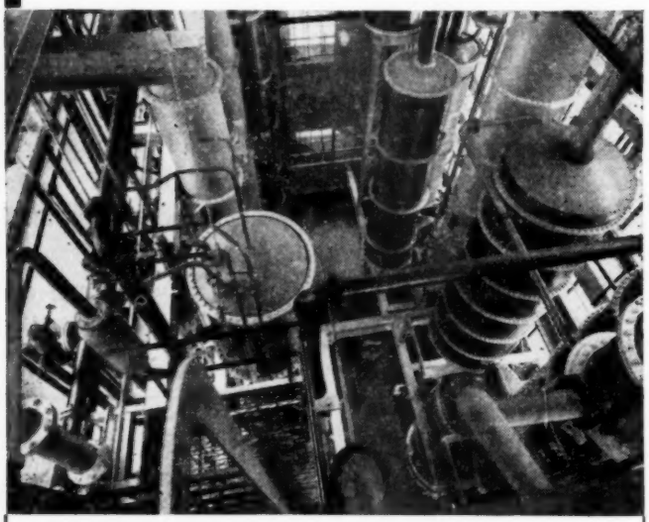

ALCOHOLS
Methanol — synthetic
Methanol — from wood distillation
Ethanol — industrial grades from molasses and grain
Ethanol — from sulphite waste liquor
Ethanol — anhydrous, Vulcan process
Ethyl alcohol — beverage, neutral spirits, beer
Isopropanol
Allyl alcohol
Butanol

ESTERS
Methyl acetate
Ethyl acetate
Isopropyl acetate
Butyl acetate
Vinyl acetate
Dibutyl phthalate
Methyl methacrylate

ALDEHYDES
Acetaldehyde
Butyraldehyde
Furfural

ETHERS
Ethyl ether
Isopropyl ether

DDT

KETONES
Acetone
Methyl ethyl ketone

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Ethylene glycol
Butylene glycol

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Chlorotoluenes
Trichlorethylene

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Heptane
Benzene
Toluene
Styrene
Diphenyl
Hexane
Alkyl Benezenes

ACIDS
Formic acid
Acetic acid — from wood distillation
Acetic acid — from process residues and solvent recovery
Acetic anhydride
Propionic acid
Butyric acid
Stearic acid
Monochloracetic acid
Salicylic acid
Fatty acids

PHENOLS
Phenol
Naphthol

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getically assisting in making an outstanding success of the membership drive.

The first meeting of the chapter will be held on October 12, in the American Legion Room located in the Pure Oil Building, Wabash Avenue and Wacker Drive, Chicago.

CLEVELAND CHAPTER

The next meeting of the Cleveland Chapter will be held Friday, October 8th. Our speaker will be Mr. L. Wilson Greene, a National Director of our Association, and Scientific Director, Technical Command, Edgewood, Maryland.

In Cleveland there is a Cleveland Technical Societies Council, which is composed of some forty technical societies. The Cleveland Chapter, AFCA, has become a member of this Council. The dues are nominal and afford each member a subscription to Cleveland Engineering, a weekly publication. We consider this a very worthwhile project in aligning ourselves with the other societies in Cleveland.

Our second meeting this fall will probably be held December 10th. No details are now available except that this meeting will be our annual elections. It had been voted in the beginning to follow the calendar year so that the newly-elected President could attend the annual meeting in the middle of his term rather than the beginning or end. So far there has been no change, but one is anticipated and urged at our next election.

Our membership remains relatively constant, in the neighborhood of 120 members. We are joining wholeheartedly with Elliott Morrill in his membership drive this fall. Major Ralph Keller is chairman of our local committee.

ORVILLE O. KENWORTHY, *President*

COLUMBUS CHAPTER

A meeting of the officers of the Columbus Chapter was held September 14, at which plans were made for a mid-October meeting of the chapter. Invitation has been extended to Conrad E. Ronneberg of Dennison University to be the speaker. Major Ronneberg taught this past summer at the Chemical Corps School, Army Chemical Center. His course had to do with protection against atomic attack.

DON C. MICHEAU, *President*

HOUSTON CHAPTER

Jack A. Barnes, President of the Houston Chapter, wired *The Journal* that their next meeting would be held early in October. They are inviting other Armed Forces Associations to attend and discuss preparations for a possible Army-Industry Conference.

NEW YORK CHAPTER

The New York Chapter intends holding its first meeting of the new season in the early part of October. This will be a dinner meeting at which it is hoped that past and present members of the Chemical Corps, both military and civilian, and members of industry who have dealt with the Chemical Corps during the past war, will be able to renew acquaintances. This year we hope to obtain a twofold purpose in the New York Chapter. One is a social purpose, namely, the getting together of a bunch of fellows who have been dealing together over the past years, and secondly, to try to do something constructive to help the Chemical Corps.

We are going to work out a program with Col. Escude of the New York Chemical Corps Procurement District, where we will work in close liaison with him, mainly in his procurement plan program. The details are being worked out at the present time and for the next *Journal* we will have more information. This chapter is also going to make an extensive effort by appointing a live-wire membership committee in increasing the membership of the New York Chapter.

The following officers were elected at the last regular meeting: President, Charles H. Brinkman; Vice President, Donald R. Calo; Secretary, S. R. Perlmutter; Treasurer, Marvin H. Silberman; PRO, John J. Geraghty; Res. and Dev., L. T. Sutherland.

CHARLES H. BRINKMAN

PITTSBURGH CHAPTER

Friday evening, 17 September 1948, officers of the Pittsburgh Chapter held a meeting at the residence of Col. George L. Seth. The expressed purpose of this meeting was to formulate plans for a general meeting on 28 October 1948. A lively discussion ensued on the best possible action to be adopted in order to increase the membership of the chapter and also to encourage attendance at the meetings. Accordingly, it was decided that at the October meeting the president would appoint committees to deal with these matters.

J. F. MATEJCZYK

ROCHESTER CHAPTER

Plans are currently under way for this year's meetings. A picnic is planned for the first meeting to be attended by members, their wives and families. In the plan for future meetings are included at least two speakers from the Chief's office. Definite schedule of meetings and programs will be announced as available.

JAMES K. LITTWITZ, *Secretary*

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ARMED FORCES CHEMICAL ASS'N

⋆WHAT THE ASSOCIATION DOES:

The members of this Association, mindful of the vital importance of chemical warfare in the field of national defense, have joined together as a patriotic obligation to preserve the knowledge derived from their war experiences and to encourage improvements in science as applied to the Chemical Corps. The objects of this Association, therefore, are to sponsor new developments designed to increase the efficiency of chemical warfare means, to collect and disseminate useful knowledge with respect to chemical warfare and related subjects, to foster a spirit of good will and cooperative endeavor among its members and with industry, and to perpetuate the friendships, memories and traditions growing out of their service with the Chemical Corps. The members of this Association and its constituent local Chapters are mutually pledged to the furtherance and promotion of these objects.

⋆WHO IS ELIGIBLE FOR MEMBERSHIP:

Any person who is or may be assigned or detailed to duty with or in the Chemical Corps, whether as officer, warrant officer, enlisted man or civilian employee, or who has been honorably discharged from such duty, and any person interested in the promotion of chemical warfare preparedness for national defense, may upon approval of the Executive Committee and payment of the annual dues hereinafter specified become a Regular member of this Association.

DO IT NOW!

If you are not now a member, fill in this application and mail it today.

TO: FRED M. JACOBS, Secretary, Armed Forces Chemical Association
1129 Vermont Avenue, Washington 5, D. C.

I hereby apply for membership in the ARMED FORCES CHEMICAL ASSOCIATION. Inclosed herewith is check or money order in the sum of:

Regular membership	$5.00 ☐	Student Membership	$ 2.50 ☐
Group membership	$100.00 ☐	Life Membership	$100.00 ☐
		Subscription Membership	$ 50.00 ☐

Of the sum remitted for dues, $2.00 is for the annual subscription for the Armed Forces Chemical Journal, and $.50 is for the annual subscription for the Armed Forces Chemical News.

I am a citizen of the United States of America with a deep sense of the obligation of every citizen to devote himself unstintingly to the cause of our nation's defense whenever the need arises. I have a particular interest in the Chemical phase of national defense.

Military affiliation or CWS activity, if any, in World War II.....

Name.....

Address.....

City.....

ROCKY MOUNTAIN CHAPTER

Rocky Mountain Chapter No. 1 did not hold any meetings during the summer months. However, President Shadle has called a special meeting of his officers for the purpose of drafting plans for the fall. Our next regular meeting date has not been set but the report of the officers' meeting will be made at that time, thus launching the fall activity program. Several interesting meetings have been considered, reports on which will be made at a later date. Our local publication, in the form of a "news letter," has made its first appearance and will continue to be published after our fall program gets under way.

K. C. CLIFTON

SAN FRANCISCO CHAPTER

The San Francisco Chapter had a meeting in conjunction with the Ordnance Association at the Palace Hotel, San Francisco.

Professor Wendell Latimer, Dean of the College of Chemistry, University of California, was the guest speaker and as his subject, spoke on Atomic Energy.

S. E. WHITESIDES, JR., *Colonel, CmlC*

WILMINGTON CHAPTER

We have had no meeting recently but hope to hold one during the first half of October. If we succeed in doing so, this will make our third meeting of the year. Our fourth meeting will be set up for late November and at that time we plan to elect our officers for the ensuing year. As an over-all plan we have been holding four meetings per year—two in the winter and early spring and two the last part of the year, with the fourth meeting scheduled as an election meeting.

R. T. YATES

PERSONNEL NOTES

Mrs. Patricia C. Jackson, formerly with the National Bureau of Standards, and James D. Wilcox, formerly with the Eagle-Picher Research Laboratory, have joined the Physical Branch, Chemical Division, Chemical Corps Technical Command, Army Chemical Center, Md., as physical chemists.

Miss Clare T. Harwood, formerly with the Chemical Division, U. S. Naval Torpedo Station, Newport, Rhode Island, has been employed as a chemist by the Anti-Persistents Branch, Protective Division, Chemical Corps Technical Command, Army Chemical Center, Md.

Recent additions to the technical staff of the Protective Division, Chemical Corps Technical Command, Army Chemical Center, Md., include Richard G. Schwartz, electronics engineer, recent graduate of the University of Minnesota; Grover C. Condon, paper technologist, recent graduate of the University of Maine; and Robert E. Fleming, chemist, formerly with Solvay Process Co.

MAJOR LUDECKE

Major Fred W. Ludecke, who recently returned from Europe where he was a member of the 7708 War Crimes Group, has been assigned to the Air Force Munitions Branch, Munitions Division, Chemical Corps Technical Command, Army Chemical Center, Md.

CAPTAIN SPAGNOLA

Captain Joseph A. Spagnola, formerly assigned to the New York Chemical Procurement District, has been assigned to the Packaging Branch, Engineering Division, Chemical Corps Technical Command, Army Chemical Center, Md.

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ITEMS FROM INDUSTRY

DU PONT SCIENTISTS GET WAR SERVICE AWARD

Three DuPont Company scientists have received the President's Certificate for Merit in recognition of their services to the nation's armed forces during World War II.

The Army and Navy, in a joint announcement, said that although the exact nature of the services performed by the three scientists cannot be revealed, the awards are based on outstanding achievements on behalf of the wartime Office of Scientific Research and Development.

To be honored are Dr. Thomas H. Chilton, Dr. Walter E. Lawson and Frederic A. C. Wardenburg, Jr. Dr. Chilton is technical director of DuPont's development engineering division, and Dr. Lawson is a staff member of the development department and was assistant director of research in the explosives department during World War II.

Dr. Lawson joined the company as a chemist in 1925. Before that he had been chief of the chemical section, medical research division, of Edgewood Arsenal and chief chemist for the Cuba Cane Sugar Corporation. In 1928, he became special assistant in the DuPont Experimental Station, and in 1933 was appointed director of the Eastern Laboratory of the explosives department. From 1939 to 1946, he served as assistant director in charge of research in the explosives department. He was appointed to his present position in 1946.

Dr. Lawson was a Marine in the first World War. He was a major in the Army Reserve from 1923 until 1940. In 1945, Dr. Lawson was a member of the Navy Technical Mission in Europe, and from October, 1945, to February, 1946, was a member of the U. S. Strategic Bombing Survey in Japan. He has been a consultant to the Chemical Warfare Service since 1925, and from 1940 to 1945 was consultant and member of the National Defense Research Council.

Dr. Lawson is First Vice President of the Armed Forces Chemical Association.

FRED FOY APPOINTED KOPPERS V.P. AND SALES MANAGER

Fred C. Foy, former vice president of J. Walter Thompson Company, recently became vice president and manager of the Sales Department, Central Staff, Koppers Corp.

SAMUEL COHEN PROMOTED

Samuel Cohen, formerly Senior Chemist for Glyco Products Co., Inc., has been appointed Chief Chemist of the Brooklyn research laboratories until they are transferred to Natrium, West Virginia. He will then assume the duties of liaison and coordination between the research, pilot plant and production departments.

ART CROSSLEY WITH DIAMOND ALKALI

Arthur W. Crossley, for the past three years assistant general manager of the Potomac Electric Power Company, Washington, D. C., has been elected treasurer of Diamond Alkali Company, it was announced recently by Raymond F. Evans, president, following action by the board of directors. During the war Crossley was a staff officer in the Industrial Division, Chemical Warfare Service, U. S. Army, which was in charge of engineering on a $350 million construction program and a $2 billion procurement and production program covering a wide range of chemical and mechanical items. He also served as a member of the War Department's Joint Logistics Plans Committee, Joint Chiefs of Staff, which implemented world-wide military planning. He served for a year as First Vice President of the Armed Forces Chemical Association.

DR. FINEBERG NEW GLYCO CHIEF CHEMIST

Dr. Herbert Fineberg has been appointed chief chemist of the Glyco Products Co., Inc., Brooklyn, N. Y., and Natrium, W. Va.

Dr. Fineberg received his Ph.D. and worked under Dr. C. S. Marvel at the University of Illinois on butadiene polymers and copolymers. With the Eastman Kodak Co. he worked on plasticizers, plastics and textile lubricants. At the Connecticut Hard Rubber Co. he developed a series of synthetic organic products, and at the Geral Chemical Co. he produced a new unique plasticizer.

GILLIE NAMED SALES HEAD IN DU PONT PLASTIC UNIT

Leslie B. Gillie of the DuPont Company has been appointed director of industrial sales of the department to succeed William A. Joslyn.

The company also announced the promotions of Edward J. Pechin, manager of plastics adver-

tising, and P. Willard Crane, technical sales manager, as assistant sales directors. Mr. Crane will direct technical service activities.

MARRAZZI HEADS TOXICOLOGY SECTION

Dr. Amedeo S. Marrazzi, formerly professor of pharmacology at Wayne University Medical School, has accepted appointment as Chief of the Toxicology Section, Medical Division, Army Chemical Center, Maryland.

Another recent addition to the staff is Dr. Carl F. Essig. He is assisting Dr. H. E. Himwich in studies of the neurophysiological action of chemical agents and in developing therapeutic measures.

DR. PRUTTON TO MATHIESON

Dr. Carl F. Prutton, formerly head of the department of chemistry and chemical engineering at Case School of Applied Science, has joined Mathieson Chemical Corporation as Director of Research, it has been announced by Thomas S. Nichols, president and chairman of the board. He will have headquarters in Mathieson's executive offices in New York and at the research laboratories in Niagara Falls.

CLIFFORD L. RICHARDS

Clifford L. Richards of the general sales staff of Merck & Co., Inc., manufacturing chemists, has established headquarters at Omaha, Neb. He will serve customers in Iowa, Nebraska, South Dakota and Wyoming.

THOENGES RETIRES FROM HERCULES PLANT

Ernest F. Thoenges, manager of Sunflower Ordnance Works, Lawrence, Kansas, will retire August 1, Hercules Powder Company announces.

Mr. Thoenges joined Hercules in 1915 at its explosives plant just outside his native city of San Francisco. He had just completed his undergraduate work in engineering chemistry at the University of California.

GOODYEAR CELEBRATES GOLDEN ANIVERSARY

The fiftieth anniversary of the Goodyear Tire & Rubber Company will be celebrated with a three-day program at Akron, Ohio, beginning October 6. Participating in the program will be some 1700 key executives of the company, several hundred of whom are being called home from all parts of the United States and from practically every foreign nation outside of the Soviet sphere.

Featuring the program will be dramatic reviews, an epic motion picture depicting the story of American opportunity and produced especially for the celebration, business sessions, addresses by top officials of the company, and a banquet.

On one day of the program, the four hundred and fifty millionth pneumatic tire will be produced in one of the Akron plants.

$1,000,000 RESEARCH LABORATORY FOR SOLVAY PROCESS

Construction has started on a new $1,000,000 research laboratory in Syracuse, N. Y., for the Solvay Process Division of Allied Chemical & Dye Corporation, according to a recent announcement by the H. K. Ferguson Company, industrial engineers and builders of Cleveland, New York and Houston, in charge of designing and constructing the project.

Of steel-frame and brick construction, the two-story building will provide 40,000 square feet of floor space. It will be equipped with the most modern laboratory facilities available to meet Solvay's extensive research program and is expected to be completed in approximately a year.

H. K. FERGUSON ESTABLISHES ATOMIC ENERGY DIVISION

The H. K. Ferguson Company, industrial engineers and builders of Cleveland, New York and Houston, announced today the formation of a new Atomic Energy Division to specialize exclusively in nuclear engineering problems.

Dr. Karl Cohen, former Director of the Theoretical Division of the Manhattan Project Laboratory, who recently joined the Ferguson Company, will direct the activities of the Atomic Energy Division, according to Wells N. Thompson, Ferguson vice president.

MATHIESON BUYS AMMONIA PLANT

The War Assets Administration and Mathieson Chemical Corporation have concluded an agreement for the chemical company to purchase the ammonia plant and ammonia oxidation facilities at Lake Charles, Louisiana. The purchase price was reported to be $7,063,300.

DR. LEUCK TO NATRIUM

Dr. Gerald J. Leuck, Director of Research of the *Glyco Products Co., Inc.*, has been transferred to the Natrium, W. Va., plant of the latter. He has been promoted to the position of technical director. Dr. Herbert Fineberg will act as his chief chemist.

Additional chemists and chemical engineers are being engaged to complete the research and development laboratories. The program for this new laboratory will include high pressure alkylations, vinylations and other organic syntheses.

From the National Secretary

By FRED M. JACOBS, *Secretary-Treasurer*

A regular Executive Committee meeting of the Armed Forces Chemical Association was held on September 14, 1948 at National Headquarters with Col. Harry A. Kuhn, President, presiding. Attending were Dr. Walter Kirner, Col. Samuel Cummings, Mr. Douglas Weiford, Mr. Alex Leggin, Col. Hepburn Chamberlain, Dr. Walter Lawson, Lt. Col. Harold Rodier, Col. Ludlow King, Mr. R. Donald Rogers, Mr. Fred M. Jacobs and Lt. Wilson (Office of the Chief, Chemical Corps).

Mr. Jacobs reported that the reassignment of individuals to chapters within the 50-mile limit, passed by the committee at the last meeting, is being accomplished on new applications and upon renewal of old ones, at which time they are checked and assigned properly. Formation of a St. Louis chapter is still pending.

After a discussion on investment possibilities of fixed reserve funds from life and sustaining memberships, Col. King made the motion, which was seconded by Dr. Lawson, that Mr. Norman be appointed as chairman of a committee to report at the next meeting on recommendations for investment of these funds. The Executive Committee will then reach a decision on the most expedient of these. The motion was passed.

Mr. Jacobs stated that since Mr. Rogers is resigning as Assistant Treasurer, he had contacted an accountant for a conference regarding the new set of books, which had been authorized by Resolution 2 of the Finance Committee's report to the meeting of August 24th. It is believed that a simple system with daily postings to be made in National Headquarters can be instituted. They can be checked monthly by our accountant, who can prepare the necessary quarterly and annual reports. Col. Chamberlain moved that the Treasurer be authorized to have the books set up and properly kept in order. The motion was seconded by Mr. Leggin and passed unanimously. Mr. Rogers stated that he will complete his duties at the end of September.

A discussion on the possibilities and types of awards to be given to students was followed with the motion by Dr. Lawson that a committee be appointed to investigate and recommend to the Executive Committee a suitable award for the outstanding student in each of the Chemical Corps ROTC units. Col. King seconded the motion, which was passed unanimously, whereupon Col. Kuhn appointed, as chairman of this committee, Dr. Lawson, who will select the rest of the members.

Col. Kuhn stated that an announcement of these awards should be made in the January *Journal* in order that enough time may be allowed for competition. A suggestion was made by Col. Cummings that the Secretary advise the Chemical Corps that the awards will be made by the Association, although their form had not yet been decided upon.

A further discussion on the subjects of awards to stimulate membership for those bringing in a number of new members, scrolls or plaques as incentives for changing from group to sustaining memberships and insignia for members, brought forth the motion by Col. King that Dr. Lawson's committee include in its report recommendations of awards or medals for all of these purposes.

Methods of further distribution of "Chemical Warfare Service in World War II" were discussed, and the motion was made by Col. Cummings and seconded by Dr. Lawson that the books be offered to members on approval. This will be accomplished by sending them prepaid return postcards. This was passed unanimously. The proposal by the Chemical Publishing Company to push the sale of our book by solicitation of their mailing list with 20,000 imprinted circulars was presented. Col. Cummings, after discussion, moved that we accept their proposal, giving them a discount on the book. Mr. Leggin seconded the motion, which was passed unanimously.

Mr. Morrill's report on the plans for the October-January membership drive were presented by Mr. Jacobs. After a brief discussion on the formation of the National Membership Committee with members from each of the chapters, Col. Cummings moved that additional credits of 50 cents per individual member and $10 per group member be allowed the chapters during this period for the purpose of financing the drive. This was seconded by Dr. Lawson and passed unanimously.

The problem of the need for more interest in the chapter meetings was again presented, with the conclusion that requests and suggestions will be sent to Col. Hepburn Chamberlain, 1600 16th Street N.W., Washington, D. C., who is to "needle" chapters by asking for information on their prospective programs.

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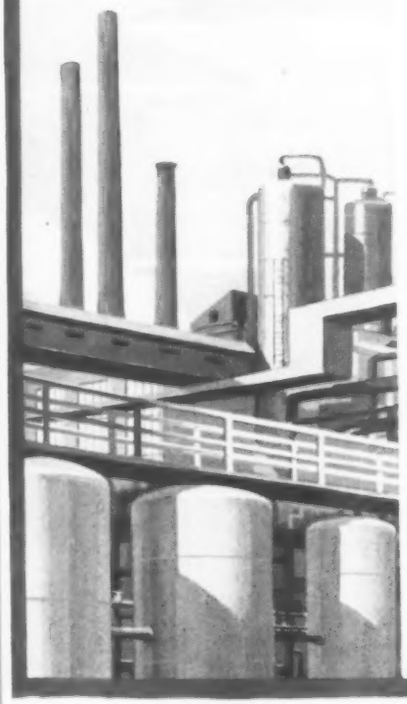

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